The dyadic interdependence of attachment security and dependency: A conceptual replication across older twin pairs and younger couples

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ABSTRACT

The dyadic interdependence of attachment security and dependency was conceptually replicated across 80 monozygotic and 47 dizygotic older twin pairs, and 214 younger heterosexual couples. Dyad members of each relationship type were similar in security and dependency. A substantial genetic contribution to dyadic attachment was indicated by higher similarity in MZ compared with DZ twins. Security and dependency were moderately correlated within individuals of each relationship type, but dyadic data analyses revealed relationship-specific patterns: The security of a dyad member correlated strongly with the dependency of the partner in both DZ pairs and couples, but not in MZ pairs. Whereas only actor effects were found in MZ twin pairs, actor and partner effects were observed in DZ pairs and couples. It is concluded that adult attachment should be generally viewed from a more dyadic perspective, one that also acknowledges relationship-specific variation.

KEY WORDS: adult attachment • dyadic relationships • romantic partners • twins

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Since Hazan and Shaver (1987) first provided empirical evidence for Bowlby's notion that adult partner attachment is an analog of infant–caregiver attachment, this topic has fascinated many social relationship researchers. The fact, however, that an adult attachment relationship basically consists of two persons has scarcely been acknowledged, and until now research has paid little attention to within- and between-dyad variations in adult attachment. The aim of the present research was to study how two facets of adult attachment, *security* to partner and *dependency* on partner (Asendorpf, Banse, Wilpers, & Neyer, 1997; Asendorpf & Wilpers, 2000), are related within the individual person and between both members of a dyad. Three different relationship types (younger couples, older identical and fraternal twins) provided the framework for a conceptual replication of the study of dyadic attachment.

Adult attachment from a dyadic perspective

Within an adult attachment relationship, two partners are likely to reciprocate each other's need for attachment with caregiving behaviors. Fraley and Shaver (1998), for example, observed in a naturalistic study on airport separations of couples that the attachment related behaviors (e.g., seeking and maintaining contact, avoidant and caregiving behaviors) were highly interdependent between dyad members (mean correlation $r = .80$). This finding suggests that attachment characterizes a dyadic relationship rather than the individual personality.

The existence of a close relationship bond does not necessarily imply that both partners will experience their attachment in the same way. Although both partners may share their views and resemble each other in their attachment feelings, they may at the same time differ to a certain extent in how secure they feel towards the other and how much they organize their lives independently of each other. For these reasons, the individual difference and the dyadic difference perspectives need to complement each other in order to separate individual from dyadic components in attachment relationships.

It is not by chance that two persons become attached to each other, but because of initial assortment effects and effects that emerge from the dynamic of the relationship itself. According to Kenny (1996), these different causes may be labeled as *compositional* and *dyadic* effects. Compositional effects are due to a given pre-existing similarity of partners that may lead them to feel attracted toward each other, and this is why these are sometimes also called 'assortative' mating effects (Lykken & Tellegen, 1993). In contrast, dyadic effects refer to dyad-specific patterns of attachment-related behaviors that emerge within the context of an ongoing relationship, and which over time lead two persons to become more or less interdependent. Compositional and dyadic effects can be ideally disentangled by following the longitudinal course of dyadic relationships from the very beginning, and by studying how dyadic attachment unfolds beyond initial assortment. As an alternative, however, it is argued here that the comparative study of various relationship types, which differ, for example,

by genetic relatedness and other features, may also provide insights into the relative importance of compositional and dyadic effects.

In the present research, dyadic interdependence was studied in three different types of close relationships, namely young adult couples, and older dizygotic (DZ) and monozygotic (MZ) twin pairs. These relationship types are profoundly different regarding the genetic relatedness of the dyad members, age, and the presence of romance and sexuality, but they are nevertheless all close relationships in which mutual attachment can be expected. Older twins and younger couples cannot be compared directly, but these different relationship types do enable a *conceptual replication* of the dyadic interdependence in attachment relationships.

Dyadic attachment in romantic couples

Only a few studies on romantic partnerships have addressed the differential dyadic interdependence of general attachment styles. For example, Collins and Read (1990) and Simpson (1990) found that anxious women tended to date avoidant men, and anxious men were more likely to attract less secure women, and vice versa. Using a prototypical approach in a study with newlywed couples, Senchak and Leonard (1992) observed high similarity in the security of both partners, although they could not identify consistent patterns in relationships between insecurely attached partners. Similarly, Kirkpatrick and Davis (1994) conducted a survey of 354 heterosexual couples and found no relationships in which both partners were either anxious or avoidant. Instead, avoidant individuals tended to mate with anxious partners. Most relationships, however, consisted of partners who were both securely attached. When adult attachment is viewed from a dimensional perspective, this line of research supports the expectation that indices of dyadic similarity are moderate, but not large, in magnitude.

Dyadic attachment in twins

Twin relationships have rarely been studied from the attachment perspective. Twin siblings are characterized by their genetic relatedness: Older MZ twins still share 100 percent of their genes, whereas DZ twins share about 50 percent. Thus, as compared with DZ twins, MZ twins strongly resemble each other in many psychological domains even in old age (Pedersen et al., 1991; Plomin, 1986). This has important implications for the attachment relationships of MZ and DZ twin pairs.

Some twin studies have found evidence for a considerable genetic contribution to infant–caregiver attachment. Finkel, Wille, and Matheny (1998) observed from a twin study on infant–mother attachment a higher concordance rate of attachment classifications for MZ pairs as compared with DZ pairs (67.6% vs. 38.5%). From a modified Strange Situation procedure involving infant twin pairs and their mothers, Gottfried, Seay, and Leake (1994) found that the existence of the co-twin provided a buffer against strong reactions to separations from the mother. Though parental caregivers still served as the main attachment figures, infant twins certainly developed intense bonds with their co-twins that were also influenced by

genetic effects. Finally, research on adult twins has revealed substantial genetic contribution to adult attachment (Brussoni, Jang, Livesley, & MacBeth, 2000).

Genetic effects on co-twin attachment probably unfold by gene→environment effects. Gene→environment effects stem from processes that predispose genotypes to look for, create, and simply find themselves in environments that suit them and that may, in turn, influence their phenotypes. People are usually born into environments that suit them (passive effect), but when they grow up they may seek even more suitable ones (active effects) or become attracted by them (reactive effects) (Plomin, DeFries, & Loehlin, 1977; Scarr & McCartney, 1983). It seems reasonable to apply these gene→environment effects to the twin relationship itself: Although the twin relationship is predetermined for both MZ and DZ twin pairs since childhood (passive effect), it can be expected that over the life course adult MZ twins are more likely than DZ twins to choose their co-twin as a close relationship partner (active effect) and, simultaneously, to be chosen by their co-twin (reactive effect) (Neyer, 2002). Driven by these genetically based effects that accumulate in MZ twins, these MZ twins should exhibit higher levels of, as well as increasing resemblance in, attachment towards each other. The same gene→environment effects operate in DZ twins, but may be less strong and therefore decrease the level of attachment and twin resemblance.

Beyond these genetic effects, the twin's attachment should also be influenced by environmental effects, such as relationship experiences inside and outside of the family of origin. But most importantly, the co-twin him- or herself represents an important part of a twin's social environment, influencing his or her attachment behavior to a certain extent. However, if compositional effects lead both twins to develop similar relationship-specific attachment feelings and behaviors, it becomes less likely that the twins influence and reinforce each other by repeated interaction patterns, such as the experience of being in good hands when needing proximity. Instead, such dyadic effects are more likely to emerge the more twins negotiate their relationship with one another, and the more they interact with each other in different social situations. The present research tested this hypothesis by relating the attachment of the twins with their frequency of contact.

Attachment security and dependency

The present study applied a relationship-specific model of adult attachment developed by Asendorpf et al. (1997). The model consists of two dimensions, a *secure–fearful* dimension reflecting attachment security, and a *dependent–independent* dimension. The independent pole of the *dependent–independent* dimension corresponds closely to Bartholomew's (1990) dismissing style, whereas the dependent pole refers to one's dependency on the relationship partner with regard to his or her affection, support, and understanding. However, the security and dependency dimensions do also seem to be related to two dimensions of the three-factor model by Collins

and Read (1990), the *close* and *depend* factors, which were found to be positively correlated and to both load negatively on avoidance (Brennan, Clark, & Shaver, 1998). Similarly, security and dependency were moderately positively correlated within individuals (Asendorpf et al., 1997). This correlation seems to express an increasing sense of reliance that partners may experience over time: The more partners become securely attached, the more they will get a sense of feeling dependent. It is therefore likely that the development of a secure attachment is accompanied by an emerging experience of dependency.

The two-dimensional model was tested in a large-scale survey of a general population sample of young German adults (N = 1179) (Asendorpf et al., 1997). The attachment scales showed sufficient reliability, and good convergent and discriminant validity with regard to different qualities of romantic relationships. Low levels of consistency of the attachment scales across different relationship types, such as partners, parents, and friends, revealed a high relationship specificity of the inner working models, as was also observed by Baldwin, Keelan, Fehr, Enns, and Koh-Rangarajoo (1996). More recently, Asendorpf and Wilpers (2000) concluded from a longitudinal study on the links between security and social support that attachment and the related inner working models have to be considered and empirically studied as qualities of social relationships rather than the individual personality.

Dyadic methodology

The present study used a dimensional approach to the dyadic interdependence of attachment, which has two advantages. First, without losing information, dyadic interdependence can be studied simultaneously from the perspective of individual differences and from the perspective of dyadic differences. Second, new methods for dyadic data analysis enable individual components to be separated from dyadic ones.

The *Pairwise Dyadic Model* by Griffin and Gonzalez (1995) applies a correlational approach that enables individual and dyadic differences to be viewed simultaneously (see Figure 1). From the individual difference perspective, the model tests the overall covariance between security and dependency that is shared by individuals. From the dyadic difference perspective, it tests, first, the variance in security and dependency that is shared between dyad members, and, second, the covariance between one's security and the dependency of the partner.

The *Latent Pairwise Variable Model* is part of the Pairwise approach and estimates latent individual-level and latent dyad-level correlations that explain to what extent the covariation between dependency and security is shared by dyad members. The model does not assume, however, that partners directly influence each other by their attachments. It rather assumes influences by unmeasured factors, such as adaptation over time, or in Kenny's (1996) terms, by a 'common fate.' A latent dyad-level correlation indicates dyadic covariance (i.e., those dyads whose members both express their security towards each other are also those dyads whose

members are likely to accept mutual dependency). In contrast, a latent individual-level correlation reflects individual covariance (i.e., the dyad member who is more secure is also the one who tends to feel more dependent on the partner).

The *Partner Effect Model* by Kenny (1996) uses a regression framework (see Figure 2). In contrast to the Latent Pairwise Variable Model, it explicitly assumes that the security and dependency of dyad members influence each other. An actor effect reveals the predictive power of the actor's security for his or her dependency that is independent of the partner's security. In contrast, a partner effect shows how an actor's dependency is a function of his or her partner's security while controlling for one's own security. Thus, actor effects correspond to individual effects, and partner effects to dyadic effects that probably result from dyadic interaction. Although the cross-sectional data presented in this study do not permit causal interpretation, this model tests the presumed direction of effects. It is supposed that compositional effects lead to actor effects, whereas dyadic effects lead to partner effects.

Hypotheses

The present research was guided by the expectation that the dyadic interdependence of relationship-specific attachment dimensions would be conceptually replicated across different relationship types:

1. It was hypothesized for each relationship type that security and dependency would both be positively correlated between partners. Owing to compositional effects, this correlation was expected to reach higher levels in MZ twins than in DZ twins.
2. It was expected that security and dependency would be moderately correlated within individuals, and that this correlation would be largely due to dyadic variation.
3. Partner effects were expected to reveal dyadic effects, and actor effects to indicate individual effects in dyadic attachment.

Method

Participants

Participants in the twin sample took part in the Genetic Oriented Life Span Study on Differential Development (GOLD) funded by the Max Planck Institute (MPI) for Psychological Research (Neyer, 2002; Neyer, Banse, & Asendorpf, 1999; Weinert, 1997). A sub-sample of 127 older same-sex twin pairs (80 MZ and 47 DZ, 49 male and 78 female pairs) with a mean age of 71.6 years (SD = 4.8) was selected for the study of dyadic attachment dimensions within the twin relationship. Like other twin studies (e.g., Pedersen et al., 1991), Neyer et al. (1999) found for the twin sample in the GOLD study that about 50% of the variance in the Big Five personality traits could be attributed to genetic differences. Therefore, the twin sample can be viewed as unbiased for genetic differences. Twins visited the MPI for five daily sessions and participated in

extensive psychological tests, including tasks on cognitive functioning, moral attitudes, personality, and social behavior. When leaving the MPI, twins were given additional questionnaires to complete when they were home and separated again. These questionnaires included items containing bipolar scales that focused on the twins' security and dependency with respect to the co-twin.

Dyadic interdependence of attachment in young adults was investigated by starting with a representative sample of young Germans between the ages of 18 and 30 years. Two thousand and two individuals who had participated in a large-scale survey conducted by the Deutsches Jugendinstitut (Bien, 1996) were contacted again and sent questionnaires on personality, social networks, attachment to partner, and other relationship-related questions (Neyer, 1999). They were informed that the intention of these questionnaires was to deepen understanding of some issues regarding their partnership and family; 661 participants (357 females) with a mean age of 25 years (SD = 3.7) responded (return rate = 33%). With the exception of a slightly higher proportion of participants with a high-school diploma, this sub-sample differed neither in socio-demographic nor in relationship-related variables (e.g., relationship duration and cohabitation status) from the representative starting sample.

About six weeks later, 385 respondents of this sub-sample who had declared that they had been in an intimate relationship for at least one year were contacted again and informed of our interest in their relationship from the perspective of their partner. They were asked to let their partner complete an additional short questionnaire that included the attachment scales and further questions concerning their relationship. (Because at least short-term stability was assumed for attachment, a 6-week interval seemed acceptable and necessary to avoid the possibility that the partners might confound each other's ratings.) All in all, 214 partners (132 males) responded (return rate = 56%). Thus, the sub-sample for studying the interdependence of attachment dimensions included 214 dyads of heterosexual couples. Partners' descriptions of relationship duration correlated r = .94. The mean relationship duration as judged by the two partners was 5.6 years (SD = 3.4).

Measures

The bipolar relationship-specific attachment scales consisted of six items measuring attachment security and eight items measuring dependency on partner (Asendorpf et al., 1997). The items were randomly mixed and presented in a 5-point agreement format rating, ranging from 1 (*not at all*) to 5 (*completely*). Reliabilities in the couple sample were satisfactory (α = .79 for security and α = .71 for dependency). Compared with the 214 participants whose partners responded to the second wave, the 171 participants whose partners refused to respond were comparable in levels of security and dependency. Moreover, there were no differences between males and females who did and did not participate. As t-tests for correlated observations showed, male and female partners did not differ in security or in dependency.

Twins were given the same scales on security and dependency. All items were, however, reformulated with respect to the co-twin relationship (e.g., 'I find it difficult to rely on my co-twin' and 'I find it easy to become emotionally close to my co-twin' measure security, and 'My co-twin must be there when I have problems' and 'I avoid being dependent on my co-twin' are items for dependency). As compared with the couple sample, the twin sample showed a somewhat higher internal consistency in dependency (α = .85) and a

TABLE 1
Means and standard deviations on attachment security, dependency, and frequency of contact

	MZ twins *n* = 160	DZ twins *n* = 94	Couples *n* = 428
Security			
M	4.48_a	4.32_b	4.35_b
SD	0.52	0.64	0.60
Dependency			
M	2.43_a	1.89_b	3.20_c
SD	0.89_a	0.74_a	0.61_b
Contact frequency			
M	3.46_a	2.61_b	4.69_c
SD	1.47_a	1.45_a	0.91_b

Note. Means in the same row that do not share subscripts differ at $p < .05$ in the Tukey honestly significant difference comparison. Standard deviations that do not share subscripts differ at $p < .05$ in the Levene's test of variance homogeneity.

comparable internal consistency in security ($\alpha = .82$). Male and female twins did not differ in security towards the co-twin. However, female participants reported higher dependency ($t(252) = 4.19$, $p < .001$, $d = .52$).

Frequency of contact between dyad members was assessed by single-item questions that differentiated contact on a scale ranging from 0 (*seldom*), 1 (*once a month*) 2, (*several times a month*), 3 (*once a week*), 4 (*several times a week*) to 5 (*every day*). This measure appeared reliable because twins agreed very much in their contact ratings (intraclass correlation *ICC* = .83, $p < .001$, in MZ pairs, and *ICC* = .78, $p < .001$, in DZ pairs). Contact ratings of young couples were available only from partners who responded to the first wave, but were also assumed to be reliable. Table 1 shows means and standard deviations on the attachments scales and contact for each relationship type.

The mean level of attachment security was highest in MZ twins, whereas DZ twins and younger couples showed comparable levels of security. Because absolute levels were high in each sample, security was not normally distributed (as indicated by Kolmogorov-Smirnov tests, $p < .01$). Nevertheless, the variances in security were homogenous across the three relationship types. Mean levels of dependency differed significantly among relationship types: the couples showed the highest level of dependency, followed by MZ twin pairs, and DZ pairs. Dependency was normally distributed in the twin samples, but not in couples (Kolmogorov-Smirnov tests, $p < .01$). Whereas variances in dependency were comparable between MZ and DZ pairs, the variance in younger couples was significantly smaller. Contact frequency was not normally distributed (Kolmogorov-Smirnov tests, $p < .01$), and differed significantly between relationship types, with the highest amount of contact observed in couples, medium levels in MZ, and the lowest rates in DZ twin pairs. The variance in contact frequency was comparable in MZ and DZ twins, while it was smaller in couples (presumably due to a ceiling affect).

Results

The dyadic interdependence regarding the security of partners (referred to as y and y') and dependency (referred to as x and x') was analyzed using the *Pairwise Dyadic Model* by Griffin and Gonzalez (1995) and the *Partner Effect Model* by Kenny (1996). Results of both methods are reported in consecutive order, because they make different assumptions.

Pairwise Dyadic Model

The Pairwise Dyadic Model is always applicable for dyads with exchangeable members, as is the case for twin relationships. In contrast, because couples are defined as dyads with distinguishable members, the pairwise approach requires the comparability of variances of attachment measures in men and women as well the comparability of covariances and cross-covariances within and between male and female partners. Gonzalez and Griffin (1997) proposed significance tests that allow these conditions to be tested.

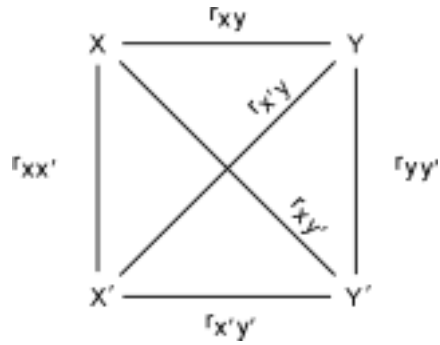
Variances in dependency ($s_x^2 = .38$ vs. $s_{x'}^2 = .35$) and in security ($s_y^2 = .36$ vs. $s_{y'}^2 = .35$) did not differ between male and female partners. Similarly, neither covariances in men ($cov(x,y) = .08$) and in women ($cov(x',y') = .10$), nor the cross-covariances between male security and female dependency ($cov(x',y) = .05$), and male dependency and female security ($cov(x,y') = .08$) were significantly different. The comparability of variances and (cross)-covariances implied no sex differences in processes that related both attachment dimensions within and between partners. Thus, the pooling of correlations across men and women appeared appropriate (Gonzalez & Griffin, 1997) (see Figure 1).

Table 2 shows the pairwise correlations, and the latent individual-level and dyad-level correlations. With the exception of the individual-level correlations r_i, which were tested using a modified t-test, the overall correlations r_{xy}, the pairwise cross-correlations $r_{xy'}$, and the dyad-level correlation r_d were tested using Z-tests that were each based on specific estimations of the effective sample sizes (referred to as k). Because the pairwise correlations $r_{xx'}$ and $r_{yy'}$ reflect dyadic variances, degrees of freedom for Z-tests were equal to the number of dyads. These tests account for the dyadic nonindependence of data (Griffin & Gonzalez, 1995).

The *overall correlation* r_{xy} reflects from the individual difference perspective that dependency and security were correlated in all 682 participants of the study: in young men or women ($r_{xy} = .24$, $Z = 4.54$, $k = 360.03$, $p < .001$), older DZ ($r_{xy} = .36$, $Z = 3.08$, $k = 73.07$, $p < .05$), and MZ twins ($r_{xy} = .25$, $Z = 2.64$, $k = 111.24$, $p < .001$). Because the overall correlations have to be interpreted as intraclass correlations, and did not differ among the three sub-samples, it can be concluded that between 24% and 36% of the variance in security and dependency was shared by all individuals. Thus, the overall correlations replicate the finding of Asendorpf et al. (1997) that both attachment dimensions were moderately related within individuals. The individual difference perspective, however, may be misleading here because this correlation probably includes individual as well as dyadic components. This will become clearer when these data are considered from a dyadic perspective.

The *pairwise correlations* $r_{xx'}$ and $r_{yy'}$ reflect the dyadic covariation of dependency and security between both dyad members. The dependency correlations $r_{xx'}$ were significant in each sub-group: in MZ twins ($r_{xx'} = .63$, $Z = 5.63$, $k = 80$, $p < .001$), in DZ twins ($r_{xx'} = .49$, $Z = 3.36$, $k = 47$, $p < .001$), and in couples

FIGURE 1
Pairwise Dyadic Model.



Lines indicate the pooled pairwise correlations between dyad members' Dependency (y,y′) and Security (x,x′). (Note r_{xy} and $r_{x'y'}$, and $r_{xy'}$ and $r_{x'y}$ are equivalent because of the pooling of correlations.)

($r_{xx'}$ = .46, Z = 6.72, k = 214, p < .001). Similarly, the security correlations $r_{yy'}$ were significant in MZ twins ($r_{yy'}$ = .66, Z = 5.90, k = 80, p < .001), in DZ twins ($r_{yy'}$ = .32, Z = 2.19, k = 47, p < .05), and in couples ($r_{yy'}$ = .34, Z = 4.97, k = 214, p < .05).

The pairwise correlations differed among groups: The value of $r_{xx'}$ was significantly higher in MZ pairs than in couples (Z = 1.98, p < .05), whereas $r_{xx'}$ was

TABLE 2
Pairwise and latent correlations between attachment dimensions in MZ and DZ twin pairs and heterosexual couples

	MZ (n = 80 dyads)	DZ (n = 47 dyads)	Couples (n = 214 dyads)
Pairwise correlations			
Overall correlation between dependency and security r_{xy}	$.25_a$***	$.36_a$***	$.24_a$***
Pairwise correlation in dependency $r_{xx'}$	$.64_a$***	$.49_{ab}$***	$.46_b$***
Pairwise correlation in security $r_{yy'}$	$.66_a$***	$.32_b$*	$.34_b$***
Pairwise cross-correlation between dependency and security $r_{xy'}$	$.15_a$	$.36_a$***	$.18_a$***
Latent correlations			
Dyad-level correlation r_d	$.23_a$	$.91_b$***	$.46_c$***
Individual-level correlation r_i	$.28_a$*	$.00_a$	$.10_a$

Note. The reported n refers to the number of dyads. Effects are based on different tests of deviation from zero that also account for dyadic nonindependence of data (Gonzalez & Griffin, 1997; Griffin & Gonzalez, 1995).
Correlations in the same row that do not share subscripts differ significantly (p < .05).
*p < .05; **p < .01; ***p < .001.

comparable in MZ and DZ pairs, and in DZ pairs and couples. Whereas couples and DZ twin pairs presented comparable levels of $r_{yy'}$, MZ pairs showed significantly higher levels of $r_{yy'}$ as compared with both DZ pairs and couples ($Zs > 2.5$, $p < .01$).

The differences between MZ and DZ twin pairs indicated a substantial genetic contribution to the attachment dimensions. Because differences between the pairwise correlations of MZ and DZ dyads reflect 50% of the genetic variance of a trait, Falconer (1960) suggested estimating the heritability by doubling the correlational difference, $h^2 = 2\ (r_{MZ}-r_{DZ})$. This estimation of heritability indicates that nearly 68% of individual differences in security and 30% in dependency were related to genetic differences. A more conservative estimate as suggested by Holzinger (1929) (i.e., $h^2 = r_{MZ}-r_{DZ}/1-r_{DZ}$) resulted in smaller estimates: 50% for security and 29% for dependency. Nevertheless, both methods were consistent in that security appeared more heritable than dependency.

Taken together, the pairwise correlations indicated that dyad members in each relationship type were highly consistent in their feelings of dependency and security towards each other. In other words, dependency and security were related at the dyadic level. It was therefore assumed that the observed overall correlation r_{xy} was to a substantial degree due to variation between dyads. At a first glance, the cross-correlations confirm this presumption.

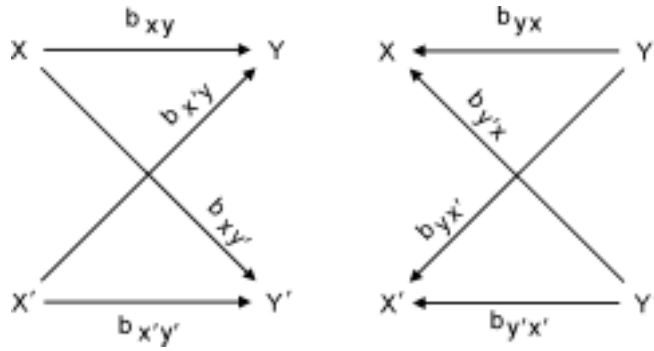
The *pairwise cross-correlations* $r_{xy'}$ show the relation between one's dependency and the security of the partner, and were significant in DZ twins ($r_{xy'} = .36$, $Z = 3.08$, $k = 73.07$, $p < .001$) and in couples ($r_{xy'} = .18$, $Z = 3.38$, $k = 352.55$, $p < .001$), but not in MZ twins ($r_{xy'} = .15$, $Z = 1.56$, $k = 108.23$, *ns*). The observed pairwise cross-correlations did not differ significantly among the three sub-samples. From a naive individual perspective, it would be surprising that the cross-correlations $r_{xy'}$ were significant in at least two cases. If the relation between dependency and security was entirely due to individual differences, one would have expected a null correlation. Individual and dyadic effects were then decomposed using the *Pairwise Latent Variable Model*.

The model allows the decomposition of the pairwise cross-correlations $r_{xy'}$ and the overall correlations r_{xy} into the latent *dyad-level correlations* and the latent *individual-level correlations*. The dyad-level correlations are latent versions of the pairwise cross-correlations disattenuated for the dyadic variations of both attachment dimensions as reflected by $r_{xx'}$ and $r_{yy'}$. The latent dyad-level correlations reflect to what extent the covariation between dependency and security was shared by both dyad members. Conversely, the individual-level correlations are disattenuated for the individual components of variance in dependency and security, thus indicating the extent of covariance between security and dependency that was not shared by dyad members, but that was due to individual differences.

Regarding couples, the dyad-level correlation r_d was significant ($r_d = .46$, $Z = 3.38$, $k = 55.14$, $p < .05$). Whereas in MZ twins r_d was relatively small and nonsignificant ($r_d = .23$, $Z = 1.56$, $k = 45.00$, *ns*), r_d was large and significant in DZ twin pairs ($r_d = .91$, $Z = 3.08$, $k = 11.46$, $p < .001$). The differences in r_d across samples were all significant ($Z > 1.99$, $p < .05$). In contrast, the individual-level correlation r_i was low and nonsignificant in couples ($r_i = .10$) and in DZ pairs ($r_i = .00$). Although r_i was small in MZ pairs, its level reached significance ($r_i = .28$, $p < .01$). The differences among the estimates of $r_{i'}$ across samples, however, were not significant.

Thus far, the correlational approach has revealed substantial dyadic

FIGURE 2
Partner Effect Model.



Lines indicate the pooled actor and partner effects between dyad members' Dependency (x,x′) and Security (y,y′). (Note effects were based on pooled regressions, thus b_{xy} and $b_{x'y'}$, b_{yx} and $b_{y'x'}$, $b_{x'y}$ and $b_{xy'}$ and $b_{y'x}$ and $b_{yx'}$ are equivalent.)

interdependence of attachment security and dependency, and the covariation of security and dependency was found to be substantially due to unspecified dyadic variation in at least two cases. The possible direction of effects was examined by using the *Partner Effect Model*.

Partner Effect Model

The analyses of the Partner Effect Model were based on pooled regressions that resulted in estimates of within- and between-dyad effects (Kenny, 1996). An *actor effect* reflects the effect of a person's level of security on his or her own level of dependency (controlling for the security of one's partner). Conversely, a *partner effect* reflects the effect of a person's level of security on his or her partner's level of dependency (while controlling for the partner's security) (see Figure 2). *t*-tests for these effects can be derived by dividing actor and partner effects by the pooled standard error of within- and between-dyad effects. Because the *df*s are approximated using the pooled standard errors, they may differ slightly from one another. Because attachment was not assessed by multiple indicators, actor and partner effects only reflect the degree to which perceptions of security and dependency were unique without separating error variance. Therefore, additional analyses were conducted to determine the amount of variance that was incremented by the effects. Table 3 shows the actor and partner effects, and the changes in R^2 that control for the complementary effect, including error.

Significant actor effects for dependency predicting security (b_{xy} = .20, Cohen's d = .58, $p < .001$) and for security predicting dependency (b_{xy} = .20, d = .62, $p < .001$) were found in heterosexual couples. But couples also showed significant partner effects from dependency to security ($b_{xy'}$ = .09, d = .25, $p < .01$) and from security to dependency ($b_{xy'}$ = .12, d = .34, $p < .001$). Similarly, DZ twin pairs showed significant actor effects from dependency to security (b_{xy} = .21, d = .73, $p < .01$) and from security to dependency (b_{xy} = .31,

TABLE 3
Actor and partner effects of attachment dimensions in MZ and DZ twin pairs and heterosexual couples

	MZ (n = 80 dyads)		DZ (n = 47 dyads)		Couples (n = 214 dyads)	
	b	ΔR^2	b	ΔR^2	b	ΔR^2
Actor effect dependency → security b_{xy}	.15***$_a$	.04	.21***$_a$	.04	.20***$_a$	.03
Partner effect dependency → security $b_{xy'}$	.00$_a$	.00	.21***$_b$	.05	.09**$_{ab}$	.01
Actor effect security → dependency b_{yx}	.45***$_a$	.04	.31***$_a$	.07	.20***$_a$	.04
Partner effect security → dependency $b_{yx'}$	–.04$_a$	.00	.32***$_b$	.07	.12***$_b$	.01

Note. The reported *N* refers to the number of dyads. Effects were tested by *t*-tests proposed by Kenny (1996).
ΔR^2 indicates the amount of incremental variance of the effect when controlled for the complementary effect including measurement error.
Differences between standardized effects across samples were examined by a test for independent path coefficients (Cohen & Cohen, 1983). Effects in the same row that do not share subscripts differ significantly ($p < .05$).
*$p < .05$; **$p < .01$; ***$p < .001$.

TABLE 4
Correlations between frequency of contact and attachment dimensions

	MZ *n* = 80 dyads	DZ *n* = 47 dyads	Couples *n* = 214 dyads
Security	$.01_{a}$	$.31^{***}_{b}$	$.15^{**}$
Dependency	$.41^{***}$	$.53^{***}_{a}$	$.29^{***}_{b}$

Note. Frequency of contact was assessed by both members of twin dyads, but by only one member of heterosexual dyads. Correlations in the same row that do not share subscripts differ significantly ($p < .05$).
$^{**}p < .01$; $^{***}p < .001$.

d = .87, p < .001), and their partner effects were significant both from dependency to security ($b_{xy'}$ = .22, d = .74, p < .001) and from security to dependency ($b_{xy'}$ = .32, d = .89, p < .001).

A different pattern was observed in MZ twin dyads. Actor effects were significant both for dependency predicting security (b_{xy} = .15, d = .77, p < .001) and for security predicting dependency (b_{xy} = .45, d = .76, p < .001), but partner effects were nonsignificant from dependency to security ($b_{xy'}$ = .00, d = .03, *ns*) as well as from security to dependency ($b_{xy'}$ = -.03, d = .06, *ns*).

Actor effects did not differ among samples. The partner effects in couples and DZ dyads predicting dependency from security were significantly different from the effects observed in MZ dyads (Zs > 2.0, p < .05). But whereas partner effects from dependency to security differed significantly between MZ and DZ dyads (Z = 1.96, p < .05), the same effects in couples did not differ significantly from MZ or DZ dyads. These results indicate dyadic and individual effects in couples and DZ pairs, but only individual effects in MZ pairs.

Attachment and contact frequency

The question whether and to what extent security and dependency were dependent on dyadic interaction between dyad members was addressed by correlations between contact ratings and attachment measures. Because the high consistency of twins in ratings of contact (*ICC*s > .78) indicated that contact could be considered as a dyadic measure, contact ratings of members of a twin dyad were averaged and correlated with security and dependency. Similarly, contact in couples – as rated by respondents of wave 1 – was correlated with attachment measures (see Table 4).

While attachment security in MZ twins was unrelated to contact frequency, it was significantly correlated with contact in DZ twin pairs. (Note that the significant correlational difference was not due to a ceiling effect in MZ twins, because variances in security and contact were homogenous in both twin groups; see Table 1). The modest correlation r = .15 (p < .01) in couples was significant, albeit not significantly different from MZ and DZ pairs. The dependency of dyad members was moderately correlated with social contact in each relationship type, with the correlational difference between DZ pairs and couples being significant (Z = 2.52, p < .01). Thus, in contrast with DZ twins and couples, security in MZ twins did not appear to depend on dyadic interaction.

Because dyadic contact seemed to play a crucial role in attachment, the actor and partner effects were re-analyzed by controlling for contact frequency in the first step of the pooled hierarchical regressions. Actor and partner effects for MZ twin pairs remained unchanged. In contrast, the effects in DZ pairs and couples decreased, but were still significant: The effect sizes of actor effects from dependency to security decreased from a large to a medium level in DZ pairs (Cohen's *d*s .73 vs. .50), whereas the decrease was smaller in couples (.58 vs. .50). Effect sizes of actor effects from security to dependency decreased to a medium level in DZ pairs (.87 vs. .52), but decreased only a little in couples (.62 vs. .53). Similarly, effect sizes of partner effects from dependency to security decreased from large to medium in DZ twins (.74 vs. .49), and became smaller in couples (.25 vs. .16). Effect sizes of partner effects from security to dependency decreased again from a large to a medium level in DZ pairs (.89 vs. .51), and became small in couples (.34 vs. .22).

Discussion

The results of the present research support the notion that attachment security and dependency should be conceptualized as characterizing dyadic relationships rather than individual persons. Although this general feature of dyadic interdependence was conceptually replicated across three different types of relationships, variation among relationship types also indicated relationship specificity. Because the study included a genetically informed twin design, these relationship-specific patterns could be partly attributed to compositional and dyadic effects.

The dyadic interdependence of attachment security and dependency

Consistent across the three relationship types, the positive and substantial pairwise correlations between the security of both dyad members were in line with expectations, showing that the security of one dyad member clearly corresponded with the security of his or her partner. Similarly, the dependency of dyad members was also substantially correlated within each relationship type. A dyadic perspective on adult attachment relationships therefore seems advisable: Whereas in infant–caregiver attachment the adult person may exclusively serve the caregiving role and is used by the child as a secure base and safe haven, these roles are more reciprocal and not separable in adult attachment relationships, and over time may become more frequently interchanged (Fraley & Shaver, 2000).

Attachment in twins. Differences between MZ and DZ twins provide evidence for a genetic contribution to attachment. This result is consistent with some twin studies that have revealed substantial heritability of attachment in infancy and adulthood (e.g., Brussoni et al., 2000; Finkel et al., 1998), as is also true for so many other features of personality and social behavior in general (Pedersen et al., 1991; Plomin, 1986, 1994). The dyadic interdependence of attachment between twins may therefore be substantially related to their genetic similarity and shared environmental

experiences. Gene→environment effects may have led twins to *choose* each other as attachment partners, and are likely to have accumulated and worked more powerfully in MZ than in DZ twins. This was also confirmed by significant mean differences, suggesting that MZ twins felt more dependent on and more securely attached towards their co-twin than DZ twins.

It has been argued here that dyadic effects become stronger the less compositional effects contribute to the interdependence of dyad members, as may be the case in DZ twins. Whereas attachment between MZ twins may be more strongly influenced by gene→environment effects, this interpersonal dynamic should be less active in MZ twins. This assumption was partly supported by the fact that attachment security in MZ twins was completely unrelated to the frequency of contact, whereas it was moderately related to contact in DZ twins. Because dyadic differences in contact have been shown as relatively stable over the adult life course of the twins (Neyer, 2002), it may be inferred that dyadic interaction of DZ twins shaped their mutual attachment security to a considerable extent. The positive correlation between dependency and dyadic contact in both MZ and DZ pairs illustrates that dependency as a relationship quality is intrinsically related to social exchanges and transfers, such as emotional support and instrumental goods. The finding that dependency in MZ twins was also influenced by dyadic contact may help to explain why dependency appeared less heritable and thus more sensitive to environmental influences than attachment security.

Attachment in couples. Genetic effects may also work in couples due to social homogamy and assortative mating, which leads the young adults to prefer partners who are similar to themselves. The degree of genetic similarity as resulting from assortative mating is presumably not very strong and cannot be quantitatively expressed as in the case of twins, because romantic partners are fairly unrelated genetically (Lykken & Tellegen, 1993).

Past research on partner resemblance has shown that the personalities of young adult partners are not very similar. Buss (1984), for example, found a positive but relatively small spousal correlation, which indicated no strong assortative mating effects in personality. Similarly, beyond a substantial initial assortment effect in personality measures, Caspi, Herbener, and Ozer (1992) observed no increase in spousal similarity over time. However, it is unclear whether assortment effects significantly account for interdependence in attachment: Young adults may pair with each other because they are similar in their attachment experiences since infancy or due to genetic dispositions. Yet, this does not necessarily imply that attachment is genetically predetermined and unchangeable by dyadic interactions through which partners influence each other over time. Although the variance of contact was restricted because of a ceiling effect, security and dependency were both positively correlated with the frequency of contact.

The plasticity of attachment development is empirically founded by research findings showing that the predictive power of early attachment experiences and the stability of working models over time are questionable

and have not been fully established (e.g., Baldwin & Fehr, 1995; Belsky, Campbell, Cohn, & Moore, 1996). Instead, an attachment relationship unfolds and is likely to change over time. Fraley and Davis (1997), for example, found in a sample of young adults that romantic attachments took approximately two years, on average, to develop.

Dyadic and individual effects between security and dependency. The moderate overall correlations between security and dependency were comparable across the three types of relationships, and replicated the finding by Asendorpf et al. (1997) that both dimensions were not orthogonal, but instead related within individuals. Thus, feeling dependent on one's partner or sibling does not necessarily imply being insecurely attached. Instead, a secure attachment seems to include considerable levels of dependency. It is therefore reasonable to assume that the partners of an ongoing relationship who feel securely attached towards each other also tend to experience mutual dependency.

Pairwise Latent Variable Model. Large and significant dyad-level correlations showed for DZ dyads and romantic couples that both security and dependency were exclusively related at the dyadic level. Dyads whose members felt more secure as compared with other dyads were also the dyads whose members felt more dependent on the other. That is, although the interdependence in either security or dependency was moderate and also suggested considerable within-dyad variability, it appeared that many dyads may have developed a joint feeling of security and a mutual sense of dependency that were dyad specific. In a romantic couple, for example, he may feel less secure than she does, perhaps because he had more difficulties transferring attachment-related behaviors from earlier experiences and because he emphasizes his independence. At the same time, she will exhibit more dependency because she relies on him as a secure base. Over time, then, both partners become increasingly involved and may learn about each other's attachment needs and capabilities to respond to these needs. Despite their individual differences, they are likely to adapt to each other and develop a shared feeling of security that corresponds to a shared sense of dependency.

In contrast, the latent dyad-level correlation in MZ twin pairs was not substantial. Because the dyadic interdependence in security and dependency was very strong and largely due to compositional effects, MZ twins were so similar in both attachment dimensions (as well as in other related areas of psychological functioning) that they did not appear to negotiate security and dependency within their relationships, as may have been the case in DZ twin pairs and couples.

Partner Effect Model. The Partner Effect Model assumes that dyad members' security and dependency influences each other, and thus specifies the directions of the possible individual and dyadic effects. Significant actor effects were found for each relationship type, but significant partner

effects were found only in romantic couples and DZ twin pairs. Whereas actor effects indicated individual effects, the partner effects revealed the tendency of dyad members to influence each other and are therefore interpreted as dyadic effects. This interpretation was partly supported by reanalyses of the partner effects: Partner effects decreased from large to medium effect sizes in DZ twins (but to a smaller extent in couples), when the frequency of dyadic contact was controlled for.

How can substantial actor and partner effects be understood? In a romantic couple, for example, she may feel strongly dependent on her partner. This may have at least two reasons. First, regardless of her own attachment security, her partner may have expressed his secure attachment towards her and have led her to feel more dependent on him (i.e., partner effect by him). Second, regardless of whether he feels securely attached to her, she may herself have felt securely attached to him, because she has a partly genetically based disposition for a secure attachment or was able to transfer attachment-related experiences from previous relationships, both of which may have increased her sense of dependency (i.e., actor effect by herself). In other words, the actor effect refers to one's own attachment dynamic, whereas the partner effect reveals a dyadic effect between both partners. This dyadic effect has supposedly resulted from dyad-specific interaction patterns, and the partnership would probably break up if this dyadic effect did not emerge. In contrast, actor effects seem due to individual effects within partners that are independent of dyadic interactions.

Small and nonsignificant partner effects indicate the absence of dyadic effects in MZ dyads. Because MZ twins showed very strong dyadic interdependence of security and dependency, it did not appear that a twin's security significantly contributed to the dependency of the co-twin. It seems as if they simply did not have to influence each other, because they were already highly compatible in both domains. The covariation between security and dependency was therefore largely due to individual effects that probably stemmed from compositional effects.

Limitations and future directions

Baldwin et al. (1996), Asendorpf et al. (1997), and Asendorpf and Wilpers (2000) observed low consistencies of attachment ratings across different relationships and interpreted these findings as indicating a high relationship-specificity of inner working models. In addition, the present study suggests relationship-specific patterns in the dyadic interdependence of adult attachment. In other words, attachment security and dependency seem to vary not only between and within individuals, but also between and within dyadic relationships, and this between-dyad and within-dyad variability is more than trivial.

The present study therefore has implications for future research. First, it may stimulate researchers to investigate attachment and the related behaviors from a more dyadic perspective. Second, it suggests that the study of attachment should be from a relationship-specific perspective,

acknowledging that different types of close relationships may include different attachment dynamics within and between partners.

The present research has several limitations. First, the three samples studied were predominantly securely attached. Therefore, it cannot be ruled out that dyadic interdependence of attachment would be different in samples of more insecurely attached relationships. Second, the samples were potentially biased, because dyads with mutually high scores on dependency and security were more likely to participate. This bias could not be controlled for, because data on nonparticipating partners and nonparticipating twin pairs were unavailable, and it remains unanswered whether the observed results would have been found in dyads with more diverging pairings regarding security and dependency. Third, the study used cross-sectional data. Therefore, it was not possible to clearly separate dyadic from individual effects. Longitudinal research is needed that studies the development of dyadic interdependence, for example, of romantic partners or close friends, from the very beginning in order to separate the initial assortment effects from the emerging dyadic effects and their possible interactions over time. Such an approach would be promising, because a dyadic relationship is unique, and its uniqueness can result from characteristics due to dyadic or individual differences. It must be one of the goals of attachment research as well as of the psychology of social relationships in general to disentangle both components, thus doing justice to both the individual person and to the dyadic relationship.

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