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Unravelling Quasi-Causal Environmental Effects via Phenotypic and Genetically Informed Multi-Rater Models: The Case of Differential Parenting and Authoritarianism

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Abstract: This study investigated the association between different experiences of parenting and individual right-wing authoritarianism (RWA) using twin family data comprising self- and informant reports. We applied a design that allowed us to examine whether the link between retrospective assessments of parenting and current RWA is effectively environmental or whether the association is attributable to genetic influences. We hypothesized that an authoritarian parenting style (low responsiveness and high demandingness) provided by the parents is associated with higher offspring's RWA, and that this association is similar for both twin siblings as a function of their genetic relatedness and shared familial experiences—that is, genotype–environment correlation. A sample of 875 twins as well as 319 mothers and 268 fathers completed a questionnaire on twins' parental environment and their own authoritarian attitudes. Additionally, 1322 well-informed peers assessed twins' RWA. Applying structural equation modelling, we found twins' experiences of parental responsiveness and demandingness to be positively associated with self-reported and peer-reported RWA. The correlation between responsiveness and RWA was similar for both twins due to their genetic similarity, whereas twin differences in demandingness were positively associated with twin differences in RWA, indicating quasi-causal environmental effects. Implications for the interdependence between parenting and RWA are discussed.
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Key words: right-wing authoritarianism; parenting; multi-rater twin family study; quasi-causality; genotype environment correlation

Investigating the influence of family environments on complex human traits, such as the impact of parenting on right-wing authoritarianism (RWA), is a difficult endeavour in light of the highly replicable result that all behavioural traits are heritable (Turkheimer, 2000). Since the genetic make-up (i.e. the *genotype*) and the environment are highly interwoven with each other (Kandler & Zapko-Willmes, 2017), findings that link certain environmental factors to an observable trait (i.e. the *phenotype*) may be confounded by genetic factors. For example, individual experiences can be driven through heritable traits that affect the selection, avoidance, or creation of certain environments or evoke specific responses from the social environment. Moreover, the parental genetic make-up can shape the offspring's environment, fostering heritable behaviours by providing a matching and stimulating environment (Scarr & McCartney, 1983). Furthermore, systematic measurement errors in the form of heritable response biases, for example acquiescence and social desirability (Kandler, Riemann, Spinath, & Angleitner, 2010), or response tendencies associated with the investigated trait itself, for example a favourable assessment of authority figures' behaviours by highly authoritarian people (Frenkel-Brunswik, 1950), may confound the results. This is precarious when the information on both environment and outcome variable are provided by the same rater.

Genetically informative studies that consider several rater perspectives, in other words genetically informed multi-rater studies, are useful to control for genetic influences and can test whether the link between an environmental variable and a complex human trait is effectively environmental. In this paper, we focus on differential parenting, defined as differences in the experience of parental treatment between siblings. Using a twin family design that incorporates several rater perspectives, we investigated whether differences in retrospectively assessed parenting can act as an environmental factor affecting twin sibling differences in RWA, or whether the association between parenting and RWA is rater-specific and (or) confounded by genetic influences, suggesting alternative explanations.

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SOURCES OF INDIVIDUAL DIFFERENCES IN RWA

Based on the work concerning the 'authoritarian personality' by Adorno, Frenkel-Brunswik, Levinson, and Sanford

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(1950), Altemeyer (1988, 1996) conceptualized and defined RWA as a core motivational value orientation. RWA comprises a strong tendency to adhere to perceived societally established and legitimate authorities and their advocated social conventions and norms. This includes negative attitudes and a pronounced level of aggressiveness towards persons deviating from these directives. Both Adorno et al. and Altemeyer argued that the development of authoritarianism is substantially influenced by the rearing environment. Altemeyer (1988) reported a significant positive correlation between parental RWA scores and those of their biological children (r = .40) as well as their adopted children (r = .55), indicating an environmental transmission from parents to offspring independent of their genetic relatedness.

Other studies provided a different picture. Twin studies, for example, have shown that the environment shared between twin siblings is of little importance for individual differences in RWA, with genetic and environmental factors not shared between twin siblings being more important (e.g. Bouchard & McGue, 2003; Funk et al., 2013; Lewis & Bates, 2013; Scarr & Weinberg, 1981). In a study on RWA and rearing environment, McCourt, Bouchard, Lykken, Tellegen, and Keyes (1999) applied a four-group twin design comprising monozygotic (MZ) and dizygotic (DZ) twins reared together and apart. They found that twins' RWA scores were significantly correlated with family moral-religious emphasis, organization, and control for individuals that were reared by biological relatives but not for adoptees. They concluded that the association between family environment and RWA is genetically mediated and, thus, variance in rearing environments does not affect individual differences in RWA beyond genetic contributions. McCourt et al. conceptualized parenting as an environmental factor objectively shared between twin siblings reared together. But do twin siblings actually receive the same parental treatment and do they perceive it equally?

DIFFERENTIAL PARENTING AND OFFSPRING'S INDIVIDUALITY: GENETICALLY LINKED?

Most studies have implemented parenting as an environmental factor shared between siblings. In their review, Collins, Maccoby, Steinberg, Hetherington, and Bornstein (2000) criticized this and noted that the offspring's individuality and the inter-connectedness of genetic and environmental factors are often not taken into account. Siblings might experience the same family environment more or less alike and subsequently show more or less congruent behaviours, based on their genetic relatedness. In addition, parents might treat their offspring in accordance with their own genetic make-up and the offspring's idiosyncratic behaviour. Parenting may thus act as a function of senders' and recipients' individuality, as Scarr (1985) put it:

> […] what people experience cannot be indexed by observations of environments to which they are exposed. What people experience in any given environment depends on what they attend to, how much they learn, how much reinforcement they feel they get for what behaviors. And what they experience in any given environment is a function of genetic individuality and developmental status. (p. 510)

A link between the offspring's parental treatment (i.e. their family environment) and the offspring's trait might thus be affected by the offspring's genotype. The nonrandom link between genetic and environmental factors has been termed as genotype–environment correlation (see Figure 1A; Scarr & McCartney, 1983). Parents usually provide both the genetic make-up and the rearing environment of their offspring. Since the rearing environment is influenced by the parental genetic make-up (Klahr & Burt, 2014), the offspring's genetic make-up and their parental treatment might be correlated, resulting in passive genotype–environment correlation. In line with this, Kandler, Bell, and Riemann (2016) reported a significant contribution of passive genotype–environment correlation (16%) to individual differences in RWA and discussed the potentially mediating role of authoritarian parenting on generational transmission of RWA (see below). Moreover, siblings might evoke different parental behaviours based on their heritable dispositions to individual behaviours—for example compliant or deviant behaviours. In other words, the offspring's genotypes might evoke similar or differential parenting as a function of their genetic relatedness. This nonrandom link between genetic and environmental factors has been termed as evocative genotype–environment correlation (Klahr & Burt, 2014).

Individuals may thus be exposed to, evoke, or experience parenting as a function of their genetic make-up. As a consequence, in order to investigate the effects of individual differences in the parental treatment on individual differences in RWA, it is worthwhile to conceptualize parenting as an environmental factor that may be shared to some degree between siblings but may also act individually.

AUTHORITARIAN AND AUTHORITATIVE PARENTING AND THE OFFSPRING'S RWA

Parenting has been most prominently defined by the level of responsiveness—that is, emotional support, acceptance, and warmth offered to the child—and the level of demandingness—the provided structure, control, and restrictiveness. Typically, four parenting styles are discerned (Baumrind, 1971; Maccoby & Martin, 1983), of which the authoritarian and authoritative parenting style have been linked to RWA. Both parenting styles feature high demandingness, although Baumrind (2013) declared authoritarian parenting to be comparably more restrictive. More importantly, both styles differ in their level of responsiveness, with authoritative parenting involving high responsiveness and authoritarian parenting low responsiveness.

In a study on the influence of the parenting type on the offspring's competence, conformity, and problem behaviour in 124 families, Baumrind (1991) found children of authoritative parents to be the most competent, socially adapted, and individuated. In contrast, children who were raised by authoritarian parents showed less prosocial and socially responsible behaviour, were less autonomous and self-regulated,

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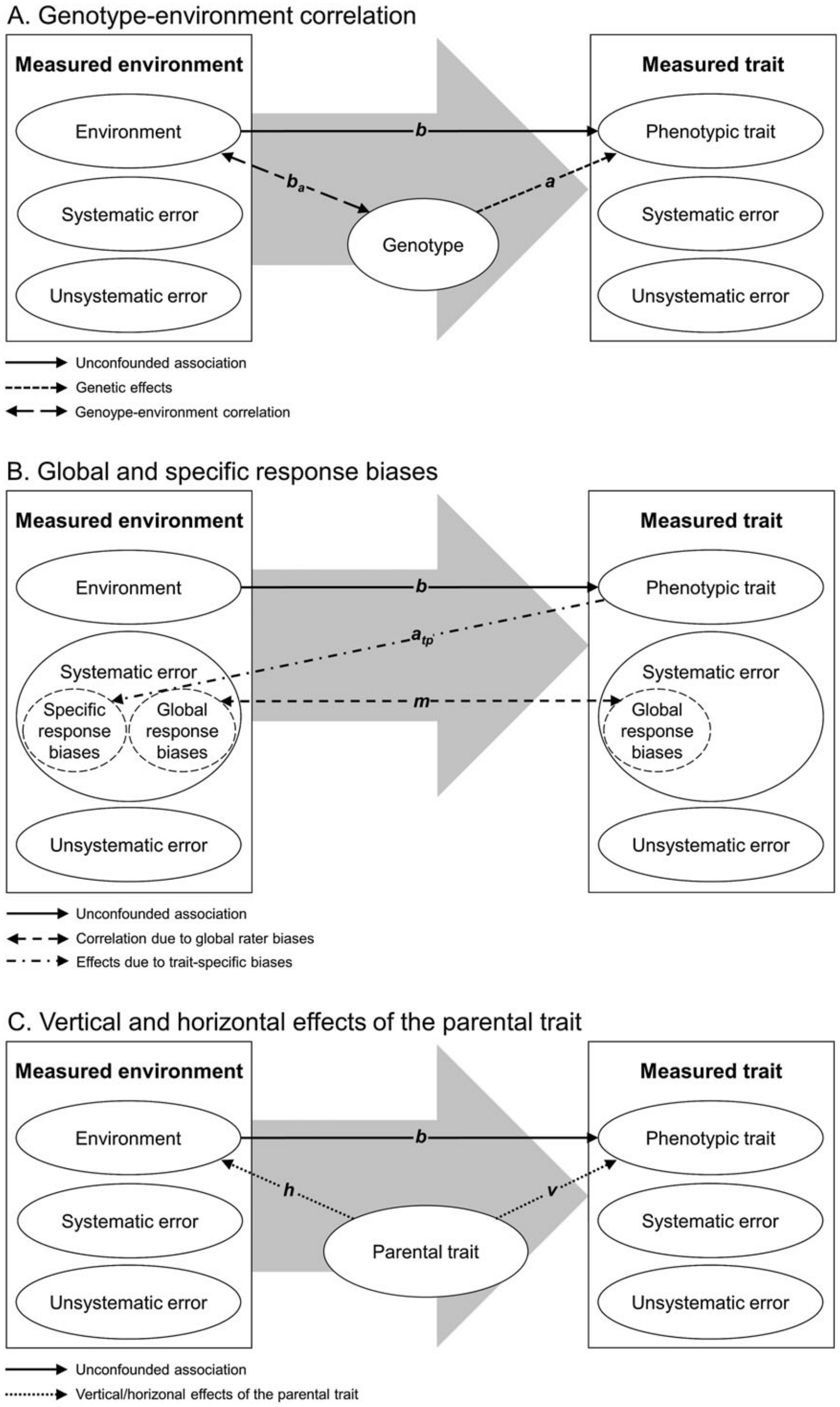

Figure 1. Schematic depiction of b = the unbiased effect of the environment on the phenotypic trait and (A) genetic contributions to the phenotypic trait (a) and a genotype–environment correlation (b_a) between the measured environment, comprising latent environment, systematic measurement error and unsystematic measurement error, and the measured trait, comprising the latent phenotypic trait, systematic measurement error and unsystematic measurement error; (B) method effects in the form of global response biases (m) that contribute to systematic measurement errors of the measured environment and measured trait, and specific response biases (a_{tp}) that contribute to systematic measurement errors of the measured environment via the rater's phenotypic trait; (C) vertical (v) and horizontal (h) effects of the parental trait on the latent environment and the phenotypic trait. All pathways can be considered by analyses of twin family data including several rater perspectives on the environment and the phenotypic trait via structural equation modelling.

tended to conform easily and showed more aggressive behaviour outside the home. These results have been replicated (e.g. Weiss & Schwarz, 1996) and indicate that parents high on RWA provide an authoritarian parenting style (e.g. Manuel, 2006; Peterson, Smirles, & Wentworth, 1997) that is associated with higher levels of RWA in their offspring.

Duriez, Soenens, and Vansteenkiste (2007) investigated cross-sectional associations between parenting and RWA as well as prospective effects of parental styles and goals on adolescent RWA. They found that both parental support (i.e. responsiveness) and parental regulation (i.e. demandingness) were positively associated with RWA in two cross-sectional studies, indicating that authoritative rather than

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authoritarian parenting is related to RWA, while their longitudinal data yielded different results: Not parenting styles, but parenting goals—that is, the parental promotion of extrinsic vs. intrinsic as well as conservation goals through their parenting—positively predicted RWA. When interpreting their findings, they pointed to the important role of rater perspectives: When parenting is captured by offspring's reports, authoritative parenting can be expected to be positively associated with the raters' RWA. Offspring high on RWA would probably not cast their parents in a negative light, since parents represent authorities, which are positively evaluated by individuals high on RWA. Consequently, while the assessment of high demandingness would probably be unbiased, as it is not necessarily perceived as detrimental, high responsiveness is socially desirable. The direction of causation underlying the association between parenting and RWA would then run into the opposite direction: Individual differences in RWA would affect individual differences in the perception or assessment of parenting.

MEASURING DIFFERENTIAL PARENTING IN LIGHT OF RESPONSE BIASES

When investigating the association between parenting and RWA, it is worthwhile to consider several rater perspectives. First, as stated earlier, offspring's RWA might bias their parenting rating, consequently inflating (or deflating) the association. One strategy to control for such *specific* rater biases might be the use of parenting assessments based on parents' reports. However, parents may also be inclined to respond socially desirable, especially with respect to their parenting (e.g. Morsbach & Prinz, 2006). In their meta-analysis, Avinun and Knafo (2014) reported different heritability estimates and different estimations of environmental influences when comparing observational, offspring's, and parental reports. They also noted that parents are less likely to report differential parenting than their offspring. As previous studies found that parents' and offspring's perception of the same family environment showed low intercorrelation (Kraemer et al., 2003; Riemann, Kandler, & Bleidorn, 2012), it may well be that parents and offspring may provide different, complementary perspectives on the same issue, such as parenting.

Apart from such specific response biases, *global* response biases such as acquiescence, severity, and leniency, might confound the association when assessments are provided by a single rater. To estimate the impact of specific response biases—in other words, the influence of the rater's RWA on their parenting ratings—independently of global response biases that pertain to all assessments, offspring's self-rated RWA should be complemented with other measures, such as informant reports. When supplemented by both parents' and offspring's reports on parenting, this would allow to control for both specific and global responses biases and get a better and more accurate insight into the underlying sources of the association between differential parenting and authoritarianism (see Figure 1B). Since rater biases might be heritable to some degree (Kandler et al., 2010), genetic influences on the association between differential parenting and offspring's RWA might not—at least not exclusively—reflect a genotype–environment correlation, but genetic differences in rater tendencies.

VERTICAL AND HORIZONAL EFFECTS OF THE PARENTAL RWA

Since the parental RWA was found to be linked with both the parenting style and the offspring's RWA (e.g. Altemeyer, 1988; Peterson et al., 1997), it is worthwhile to consider the parental RWA as a factor contributing to the association (see Figure 1C). Apart from genetic transmission, the parental RWA might directly affect the offspring's RWA through parental right-wing authoritarian behaviours that can be observed, imitated, and adopted, which might be in turn rewarded (genotype–environment correlation). To reflect this direct intergenerational transmission (independent of concrete genetic and environmental contributions), we termed it the *vertical* effect of the parental RWA on the offspring's RWA. Parental authoritarianism could also indirectly affect the offspring's RWA and associated behaviours through more or less warm and demanding parenting. To differentiate this indirect intraindividual effect of the parental RWA on the parenting style from the direct vertical effect, we termed it the *horizontal* effect of parental authoritarianism on their parenting style.

As a consequence, the parenting style might function as a mediator between the parent's and offspring's RWA. Since RWA is moderately heritable, such a mediation might be genetically driven and reflect passive genotype–environment correlation. When genotypes and shared family environments are correlated, twins' similarity increases irrespective of their genetic relatedness as a function of shared environmental factors (Briley, Livengood, & Derringer, 2018).

By taking the parental RWA into account, it is possible to further differentiate whether findings pointing to a genetic effect indicate a direct genetic transmission, a passive, or even an evocative genotype–environment correlation.

MODELLING FRAMEWORK IN A NUTSHELL: ASSUMPTIONS AND PARAMETERS

Measurement of both the environmental variable and the trait can be decomposed into the true score (i.e. the latent environmental variable or latent trait), systematic measurement error and unsystematic measurement error. Since RWA is heritable (a) and since individuals may be exposed to, evoke, or seek environments in accordance with their genetic makeup, the individual's genotype and environment may be correlated (Figure 1A; b_a). The association between experienced parental treatment and RWA can be confounded by a shared genetic basis in the form of a passive or evocative genotype–environment correlation, that is, due to the offspring being raised in a parenting environment in accordance with their genotype (a passive genotype–environment correlation), or the parents reacting to the offspring's genetically driven behaviour (an evocative genotype–environment correlation).

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Further, partially heritable response biases both pertaining to a measurement method, such as self-reports (in the following *global response biases*; *m*), and/or due to the specific trait of interest, namely RWA (in the following *specific response biases*; a_{tp}), can inflate the systematic error variance and subsequently confound the association between parenting and RWA (Figure 1B).

If the family environment in question is provided by genetically related individuals, such as the parents, the offspring's trait can be linked to the parents' traits as a consequence of genetic transmission (in the following *vertical effects*; *v*) and/or due to the parents providing the rearing environment in accordance with their trait level (in the following *horizontal effects*; *h*; Figure 1C).

With the help of twin family data (including informant reports) and structural equation modelling, we could explore whether the association between twins' parental treatment and their RWA is genetically confounded or effectively environmental, and to what extent response biases and the parental phenotypic trait contribute to the link.

THE PRESENT MULTI-RATER TWIN FAMILY STUDY

The current twin family study investigated the association between individual differences in retrospectively reported parenting—assessed by parents and offspring—and individual differences in offspring's current RWA—captured by self-reports and ratings of well-informed observers. In line with Baumrind's (2013) suggestions, from a strictly phenotypic point of view, we hypothesized that the offspring's RWA would be negatively predicted by parental responsiveness (Hypothesis 1.1) and positively predicted by parental demandingness (Hypothesis 1.2). Yet, in accordance with previous findings (McCourt et al., 1999), we expected a genetic contribution to the link between parenting and RWA (Hypothesis 2) for both responsiveness and demandingness, and this genetic mediation should reflect evocative genotype–environment correlation (Hypothesis 3).

To examine whether phenotypic associations reflect an at least partially environmental effect of parenting on RWA as opposed to a complete genetic confounding, we first tested the hypotheses by applying bivariate structural equation modelling on twin data, termed *genetically informative regression models* (Turkheimer & Harden, 2014). To better fathom and identify potentially underlying structures and mechanisms contributing to the association, we further ran analyses based on structural equation modelling that did not consider the genetic relatedness of the twins, which we termed *phenotypic semilatent multitrait-multimethod (MTMM) analyses*. These phenotypic semilatent MTMM analyses allowed us to isolate common and specific variance (i) in offspring's, mother's, and father's accounts on parenting and (ii) in self-reports and peer reports on offspring's RWA, and to consider (iii) self-reports on maternal and paternal RWA. This analytic strategy allowed us to identify rater-specific covariance due to influences of response tendencies and influences of parental RWA on their parenting and offspring's RWA. Such response tendencies comprise global response biases, such as acquiescence, leniency, severity, and social desirability pertaining to both the assessment of parenting and the self-reports on RWA, and specific response biases due to the rater's characteristic of interest, in this case biases due to the rater's RWA. Parental RWA may have a direct vertical effect on offspring's RWA due to vertical genetic transmission, as well as an indirect horizontal effect on offspring's RWA via their parenting style.

The model estimates were quasi-cross-validated[1] across both twins of a twin pair to confirm the predictive value of the tested models. This also helped to reduce potential type 1 error inflation, for which we did not control in favour of stabilization of type 2 error. As retrospective assessments do not allow for causal inferences and retrospective reports on parenting might be biased by the current RWA as well as other traits and experiences (e.g. being a parent oneself), the consideration of rater-specific effects in the MTMM analyses strengthens the credibility of the findings.

If a significant phenotypic association between parenting and RWA beyond the aforementioned confounding factors can be found and the association is not solely driven by genetic factors shared by both twins, the association between parenting and RWA would be at least partly environmental, supporting the notion that individual differences in RWA are indeed affected by individual differences in experienced parental treatment—or other confounding environmental factors. For example, if the association is confounded by environmental factors shared by the twins, this could reflect parenting influences on RWA shared by twins or that the association could be due to a third environmental factor influencing both parenting behaviours towards the twins and twins' RWA in the same vein, for example the socioeconomic status (Carvacho et al., 2013; Heydari, Teymoori, & Haghish, 2013; Hoff, Laursen, & Tardif, 2002) or parenting goals (Duriez et al., 2007).

A found genetic or shared environmental contribution based on the genetically informative regression analyses in combination with the results of the phenotypic semilatent MTMM analyses would allow for four different explanations for the association between parenting and RWA: (i) *passive genotype–environment correlation*, if the association is due to shared environmental factors, valid across rater perspectives, and mainly mediated by parents' RWA; (ii) e*vocative genotype–environment correlation*, if the association is due to genetic factors, valid across rater perspectives, but not driven by parents' RWA; (iii) *genetically driven perceptions or assessments of parenting due to raters' RWA*, if the association is due to genetic factors, accounted for by twins' RWA affecting twins' but not parents' parenting rating; and finally (iv) covariance due to shared *rater biases*, if the association is due to genetic or shared environmental factors and explained by rater-specific perspectives. The explanations are not mutually exclusive. That is, all explanations can account for the link between assessments of parenting and RWA.

[1]This is no direct and full cross-validation, because twin siblings of a pair are not independent and share the same parents.

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Table 1. *JeTSSA sample information and descriptive statistics for RWA, responsiveness, and demandingness*

		Age			RWA				Responsiveness				Demandingness			
Rater and sex	N_{all}	*N*	*M*	*SD*	*N*	*M*	Range	*SD*	*N*	*M*	Range	*SD*	*N*	*M*	Range	*SD*
Self-reports																
Female twins	648	638	35.10	13.72	644	2.72	1.00–4.36	0.57	626	3.87	1.00–5.00	0.79	643	2.83	1.13–5.00	0.75
Male twins	227	226	32.04	13.15	226	2.78	1.00–4.45	0.63	220	3.94	2.00–5.00	0.61	224	2.90	1.38–4.75	0.61
Mothers	319	313	56.50	10.64	313	2.95	1.00–4.45	0.59	317	4.52	2.40–5.00	0.41	315	2.97	1.00–5.00	0.65
Fathers	268	249	58.37	10.35	261	3.08	1.09–4.73	0.60	268	4.38	2.00–5.00	0.49	265	2.95	1.00–5.00	0.65
Peer reports																
Female twins	986[a]				557[b]	2.77	1.14–4.09	0.49								
Male twins	336[a]				190[b]	2.86	1.18–4.18	0.58								

Note. Means, ranges, and *SD*s are based on mean scores across all items of a scale.
[a]Overall number of peers rating female or male twins.
[b]Overall number of peer reports after averaging peer reports for twins for which two peer reports were available.

Table 2. *Correlations between family members' assessments of parenting and their RWA*

	Responsiveness			Demandingness			RWA		
Family dyad	*n*	*r*	95% *CI*	*n*	*r*	95% *CI*	*n*	*r*	95% *CI*
MZ Twin 1 – Twin 2	209	.746	[.679, .801]	209	.580	[.482, .663]	225	.672	[.593, .738]
DZ Twin 1 – Twin 2	152	.531	[.406, .636]	152	.421	[.281, .544]	166	.414	[.279, .533]
Father – Twin 1	245	.391	[.279, .492]	245	.339	[.223, .445]	258	.331	[.218, .436]
Father – Twin 2	222	.239	[.111, .359]	222	.258	[.131, .377]	235	.258	[.134, .374]
Mother – Twin 1	253	.381	[.270, .482]	253	.359	[.247, .462]	280	.422	[.321, .514]
Mother – Twin 2	281	.328	[.219, .429]	281	.324	[.215, .425]	311	.401	[.303, .490]
Father – Mother	202	.348	[.221, .464]	202	.335	[.206, .452]	218	.512	[.407, .604]

Note. Parenting correlations are based on factor scores uncorrected for age differences; MZ: monozygotic; DZ: dizygotic. All correlations were significant ($p < .001$).

METHODS

Participants

We analysed data from 875 twins reared together and 587 parents of twins from the Jena Twin Study of Social Attitudes (JeTSSA; Stößel, Kämpfe, & Riemann, 2006). The twins included 226 MZ sibling pairs, 168 DZ pairs (101 same-sex and 67 opposite-sex pairs), and 87 unmatched twins. Twins ranged in age from 17 to 82 years ($M = 34.30$; $SD = 13.62$), of whom 74% were female.[2] The sample's educational and occupational background was heterogeneous. For a more detailed sample description, see Table 1 and Stößel et al. (2006).

In addition to self-raters, 1322 well-informed acquaintances of twins provided peer reports on twins' RWA. For each twin sibling, different peers provided assessments with preference given to those peer raters who knew one twin very well but not the co-twin. For 86% of twins, at least one peer report, and for 66% of twins, two peer reports, which were averaged for analyses, were available (see Table 1).

[2]Even though it is standard to control for age effects, we decided not to control for age differences in RWA and parenting. Since parenting and authoritarianism, similar to conservatism, may change over time due to zeitgeist and socio-political developments, age itself might reflect or be linked to factors that act to increase twins' similarity in RWA and authoritarian parenting (e.g. older people tend to be more authoritarian and to have received a more authoritarian parental treatment). We did not want to partial out variance due to those potential shared environmental effects and thus decided to leave possible age effects statistically uncontrolled.

Measures

RWA

A German version of Altemeyer's RWA scale (1988, 1996), the 12-item RWA[3]D scale (see Funke, 2005), was implemented. Items were rated on a 5-point scale, ranging from 1 (*Strongly disagree*) to 5 (*Strongly agree*). Item descriptions have been reported elsewhere (Kandler, Bell, & Riemann, 2016). One item ('People ought to develop their own moral standards of "Good and Bad" and to put less attention to the Bible and other old traditional beliefs.') was omitted due to an insufficient item-total correlation in both the self-reports and peer report data. For structural equation modelling, RWA scores were z-standardized. The internal consistency ranged from (Cronbach's) $\alpha = .675$ (father's report) to $\alpha = .743$ (twin's report) for self-reports and was $\alpha = .746$ for peer reports. Factor analyses exploring the unidimensionality of RWA item assessments are provided in Supporting Information A. Descriptive statistics are shown in Table 1, and correlations between family members' self-reports are displayed in Table 2. In contrast to twins' self-reports, correlations between twin siblings based on averaged peer reports were more similar across MZ and DZ twin pairs: $r = .493$, $n = 176$, 95%*CI* [.372, .597], for MZ twins, and $r = .445$, $n = 134$, 95%*CI* [.298, .571], for DZ twins. These differences could be due to response tendencies, for example acquiescence or social desirability, and/or due to additional valid information inaccessible to the peers, such as inner thoughts and feelings. If these error or trait variance

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components are genetically influenced, correlations between self-reports of MZ twins will be higher than DZ twin correlations (Kandler et al., 2010). For a thorough discussion of different rater perspectives on ideological attitudes, see Cohrs, Kämpfe-Hargrave, and Riemann (2012). Please note that Cohrs et al. relied on the same multi-rater twin data in their study 2.

BEQ

Twins and parents filled out the German version of the Block Environmental Questionnaire (BEQ; Harmening, 2014; Hur & Bouchard, 1995; Riemann & Wagner, 2000)—a retrospective measure of family environment. Twins rated maternal and paternal treatment based on 81 items (concerning maternal and paternal acceptance/rejection, family cohesion, maternal and paternal intellectual-cultural orientation, and family organization), and parents rated their own parental behaviour based on 54 items on a 5-point scale, ranging from 1 (*Strongly disagree*) to 5 (*Strongly agree*).

For the purpose of the current study, we selected BEQ items that—in accordance with theoretical considerations (Baumrind, 1971, 2013; Maccoby & Martin, 1983)—referred to specific parental behaviour related to either responsiveness or demandingness, in other words imply shown affection and supportive actions adapted to the child's needs or monitoring and restrictive actions aimed at providing structure and order in the child's environment and aligning the child's behaviour with social norms. In order to confirm this selection, we took the following steps: (i) we ran internal consistency analyses for both subscales and excluded four inconsistent items; (ii) we calculated principal axis analyses using varimax rotation in order to see whether the kept items load on two factors in accordance with the theorized two-dimensional structure; and (iii) finally, since the dimensions are supposed to be independent (Baumrind, 2013), we computed orthogonal factor scores using the Anderson-Rubin method (Anderson & Rubin, 1956). At the end, we kept 22 items in the twins' version, 14 of which capture responsiveness and 8 demandingness, and 16 items in the parents' version, 10 items reflecting responsiveness and 6 measuring demandingness. See Supporting Information A for more details regarding factor analyses and psychometric quality. Descriptive statistics of averaged item scores are provided in Table 1. Correlations between family members' reported responsiveness and demandingness are shown in Table 2. All family–dyad correlations were positive and statistically significant ($p < .001$). All correlations between parents and twins as well as between mothers and fathers were comparable across responsiveness and demandingness. In addition, and in line with previous research (Kraemer et al., 2003), no correlation was larger than $r = .40$, indicating substantial differences between parents and offspring as well as between mothers and fathers in the perception or assessment of parenting. This might also be due to the parents' not rating the parenting of each other, leading to a variance component not shared between offspring's and parents' ratings. This lack of measurement invariance might have contributed to additional incongruence concerning these correlation analyses. The comparatively low mother–father correlation in responsiveness and demandingness may indicate substantial differences between mothers and fathers in the treatment of their children.

Analyses

Structural equation models (SEM) were run based on the statistical software package IBM SPSS Amos 21.0 (Arbuckle, 2012). All SEM-based estimates were derived via full information maximum likelihood procedures to analyse all available data and handle missing values due to dropout (Little & Rubin, 2002). See https://osf.io/mecfb/ for Amos scripts and outputs (the latter as Excel files).[3] Due to the sample size and related issues of statistical power, we performed the genetically informative and MTMM analyses separately.

Genetically informative regression analyses

Based on data provided by twins reared together, sources of individual differences in psychological traits can be split into an additive genetic component (*A*) and two environmental components due to environmental influences shared (*C*) and not shared by twins including measurement error (*E*). DZ twins share on average 50% of their segregating alleles, whereas MZ twins share 100% of their genetic make-up. Both MZ and DZ twins reared together share environmental factors that act to increase twin pairs' similarity. Assuming that these shared environmental influences affect DZ twins' resemblance to the same degree as they contribute to the similarity of MZ twins, differences between MZ and DZ twin similarities can be attributed to genetic influences, whereas within-pair differences are attributable to nonshared environmental influences. Strong shared environmental influences that act to make twins more similar are indicated in case of low within-pair differences and low differences between MZ and DZ twin similarities.

The classic twin model (CTD) cannot take assortative mating into account, which might lead to an overestimation of the effect of shared environmental factors and an underestimation of the genetic contribution. Assortative mating of twins' parents might inflate DZ twin correlations as a result of the parental genetic similarity. It does not affect MZ twin correlations, as their perfect genetic similarity cannot be increased. This inflation consequently diminishes the difference between MZ twin pair correlations and DZ twin pair correlations, culminating in skewed estimates. Since twin and parental estimates on RWA were available, we could adjust the initial assumption of 50% of shared genes between DZ and control for parents' similarity and thereby assortative mating (see Kandler, Gottschling, & Spinath, 2016): As both the heritability [$h^2 = 2 \times (r_{MZ} - r_{DZ})$] of RWA taking assortative mating into account and spouse similarity (μ) in RWA was about .50 (see also Table 2), the genetic correlation between DZ twins ($\gamma_{2(DZ)} = .50$) in the CTD could be corrected as follows: $0.5 + 0.5 \times h^2 \times \mu = 0.5 + 0.5 \times 0.5 \times 0.5 = 0.625$ (see Martin et al., 1986, or Stieger, Kandler, Tran,

[3]Note, the JeTSSA dataset is not public domain. Therefore, the data can only be used to reproduce the results presented in this study. Requests for data use for own research projects should be sent to the principal investigator Rainer Riemann (rainer.riemann@uni-bielefeld.de).

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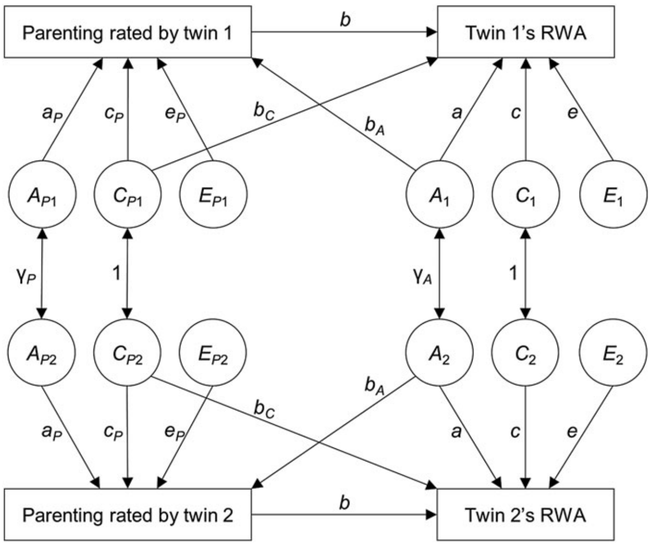

Figure 2. Genetically informative model of the regression of RWA on parenting (i.e. responsiveness or demandingness). $A_{P1}/A_{P2}/a_P$ = additive genetic factors/effects on parenting; $A_1/A_2/a$ = additive genetic factors/effects on RWA; $C_{P1}/C_{P2}/c_P$ = common environmental factors/effects on parenting; $C_1/C_2/c$ = common environmental factors/effects on RWA; $E_{P1}/E_{P2}/e_P$ = unique environmental factors/effects on parenting (including measurement error); $E_1/E_2/e$ = unique environmental factors/effects on RWA (including measurement error); b_A = effect on parenting due to correlated genetic factors between RWA and parenting; b_C = effect on RWA due to correlated shared environmental factors between RWA and parenting; b = effect on RWA controlled for genetic ($a \times b_A$) and shared environmental mediation ($c_P \times b_C$); γ_1 = 1.0 correlation between monozygotic twin siblings, 0.5 between dizygotic twin siblings; γ_2 = 1.0 correlation between monozygotic twin siblings, 0.625 between dizygotic twin siblings after adjustment for assortative mating.

Pietschnig, & Voracek, 2017, for more details on the correction for assortative mating). As a result, we specified the genetic correlation of MZ twins at $\gamma_{2(\text{MZ})} = 1$ and the genetic correlation of DZ twins at $\gamma_{2(\text{DZ})}{}' = .625$ in our CTD of RWA.[4]

The CTD also assumes the absence of genotype–environment interplay, although both genotype–environment correlations and interactions might inflate estimates of *A*, *C*, and *E* (see Bleidorn, Hufer, Kandler, Hopwood, & Riemann, 2018, and Bleidorn, Kandler, & Caspi, 2014). The applied models allowed us to investigate to what extent genotype–environment correlations might play a role.

Bivariate *ACE* twin models allow for genetic and environmental links between two variables (see Figure 2). In the current study, the bivariate twin model allows for estimations of regressions from twins' rated parenting on genetic variance in twins' RWA (b_A), which can reflect genetically influenced response biases shared between both measures (global response bias) or due to twins' RWA (specific response bias), and/or evocative genotype–environment correlation that act as a function of siblings' genetic relatedness (Briley et al., 2018). The model also allows for regressions from twins' RWA on shared environmental variance in twins' rated parenting (b_C), which can reflect effects of parenting on RWA shared by twins, shared environmental factors affecting both parenting and RWA, and/or passive genotype–environment correlation that act as a function of siblings' shared family environment (Briley et al., 2018). Controlling for these confounding genetic ($a \times b_A$) and environmental links ($c_P \times b_C$), a regression from RWA on retrospective experiences of parenting (b) would suggest a quasi-causal effect in terms of non-confoundedness regarding genetic and shared environmental influences (see Turkheimer & Harden, 2014, for more details). That is, twin differences in retrospectively reported parenting would predict twin differences in the level of RWA. These models allow us to infer only quasi-causality, because they cannot exclude possible confounding factors not shared by twins, for example a differential memory bias of retrospective information. However, in any case, those confounding factors must be effectively environmental.

The bivariate twin model analyses were run on the basis of twins' retrospective assessments of parental responsiveness and demandingness on the one hand and self-reports and peer reports on twins' RWA on the other, testing Hypotheses 1.1, 1.2, and 2. For all four associations, the full bivariate twin model was tested against three reduced regression models nested within the full model: (i) Latent *A* regression model: $b_C = 0$; (ii) Latent *C* regression model: $b_A = 0$; and (iii) Phenotypic regression model: $b_A = b_C = 0$. The phenotypic regression model, where both latent b_A and b_C regression paths were fixed to zero, was the most restrictive model not allowing for confounding genetic and shared environmental factors. It tested Hypotheses 1.1 ($b < 0$) and 1.2 ($b > 0$). The model comparison between the phenotypic regression model and more complex models tested for the quasi-causal effect from parenting on RWA. The latent *A*

[4]We did not adjust assessments of parenting behaviours for assortative mating primarily due to conceptual considerations. First, parenting is not a phenotype per se but a feature of twin's family environment. Second, fathers' and mothers' self-reports on their own parenting are not equivalent to twin reports on their experienced parental treatment, because twins rated both parents' behavior, while parents rated only their own behaviours. As a consequence, it would be unclear, to what extent assortative mating, social homogamy, shared social background, or spousal interactions (assimilation, accommodation) affect similarity in parents' parenting. Adjusting objectively (but not necessarily effectively) shared family environments for the shared component would artificially result in variation due to effectively not shared environmental influences (i.e. only differences between maternal and paternal treatment). Thus, adjustment for assortative mating is problematic in case of parenting.

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regression model allowed for genetic factors (partially) accounting for the association, testing Hypothesis 2 ($b_A \neq 0$). The latent *C* regression model controlled for shared environmental factors (partially) explaining the association. Likewise, the full (latent *A* + *C* regression) model tested for both confounding factors.

The overall model fit was evaluated by the root mean square error of approximation (RMSEA) and the comparative fit index (CFI). A good model fit would be indicated by RMSEA < .05 and CFI > .95 (Hu & Bentler, 1999; Steiger, 1990). Nested model comparisons were run using the χ^2-difference test. In other words, the phenotypic regression model was tested against the latent *A* regression model or the latent *C* regression model, which in turn were tested against the full regression model. In addition, we used the expected cross-validation index (ECVI; Browne & Cudeck, 1993) and the CFI for descriptive comparisons of non-nested models. A higher CFI and a smaller ECVI indicate a better model fit. Thus, the latent *A* regression model was compared to the latent *C* regression model in this regard.

Phenotypic semilatent multitrait-multimethod analyses

In order to further complement findings from the genetically informative regression models, we inspected the association for several confounding factors by running phenotypic semilatent MTMM analyses for both parenting dimensions separately by considering several rater perspectives for parenting as well as for the offspring's RWA (see Figure 3). The latent variable *parenting* accounts for the correlations between parents' and twins' ratings of parenting, whereas the latent variable *twin's RWA* accounts for the common variance in self-reports and peer reports on twins' RWA. By including several rater assessments for both the predictor and the outcome, rater-specific effects pertaining the self-rater method could be taken into account. These include global rater biases and specific response biases associated with the criterion (i.e. RWA) itself. Accordingly, the model allows for common method variance in twins' parenting rating and their RWA self-rating (m_t) as well as for the influence of the twin's latent RWA on the twin's parenting rating via regression of *twin's parenting rating* on the latent variable *twin's RWA* (a_{tp}). If the latent regression of *twin's RWA* on *parenting* (b) remains significant in the presence of potentially confounding global and specific response biases, despite concomitant effects possibly counteracting the association's direction and consequently suppressing the regression, the association between parenting and twin's RWA can be considered to be valid across different rater perspectives. If a significant genetic mediation between parenting and offspring's RWA is found (Hypothesis 2), a significant latent regression b may reflect evocative genotype–environment correlation, in line with Hypothesis 3.

To disentangle different kinds of genotype–environment correlations as potential accounts of the association between parenting and RWA, the aforementioned model was extended by including self-rated parental RWA (see Figure 4). This model allows for horizontal influences of maternal and paternal RWA on parenting (h_f, h_m), vertical influences of parental RWA on the offspring's RWA (v_f, v_m), and consequently two further potentially confounding factors of the association between parenting and twin's RWA, namely mother's and father's RWA, can be taken into account. In addition, the model takes account of global response biases reflected by residual correlations between parental ratings of their parenting and own RWA (m_f, m_m). Thus, this model allowed to rule out further confounding effects due to rater-specific perspectives, a vertical transmission of RWA and a mediation of this vertical transmission via parenting. If Hypothesis 2 can be supported, a significant latent regression b without horizontal effects (i.e. $h = 0$) may reflect evocative genotype–environment correlation, whereas a shared environmental mediation in the genetically informative regression model and a mediation via parental RWA in the phenotypic semilatent MTMM analysis (i.e. $h \neq 0$ and $v \neq 0$) would support a passive genotype–environment correlation, in line with Hypothesis 3.

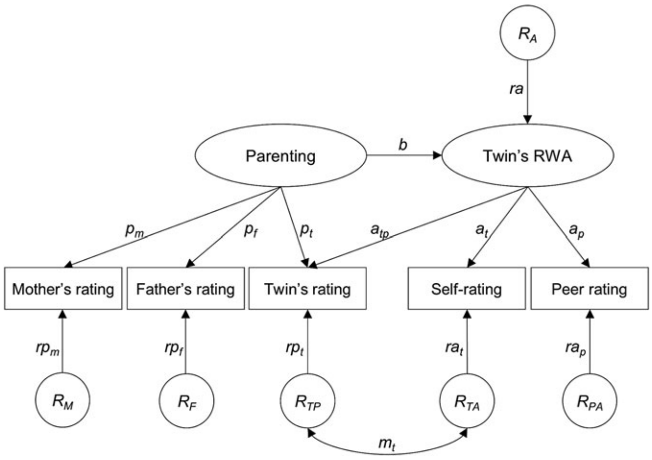

Figure 3. Phenotypic semilatent multitrait-multimethod model. Parenting and the twin's RWA are plotted as latent variables, with loadings of maternal (p_m), paternal (p_f), and twin's (p_t) assessments of parenting on latent parenting, with loadings of twins' self-rating (a_t) and peer ratings (a_p) as well as a blended loading (a_{tp}) of twin's parenting rating on latent twin's RWA, and with a regression b from twin's RWA on parenting. All residual variables (R_M, R_F, R_{TP}, R_{TA}, R_{PA}, and R_A) are uncorrelated, except within-rater residual components, namely twins' assessments (m_t). All variances of exogenous variables and a_t as well as a_p are fixed to 1 for model identification and in order to freely estimate all other paths coefficients. For more details on parametrization and model specification, see text.

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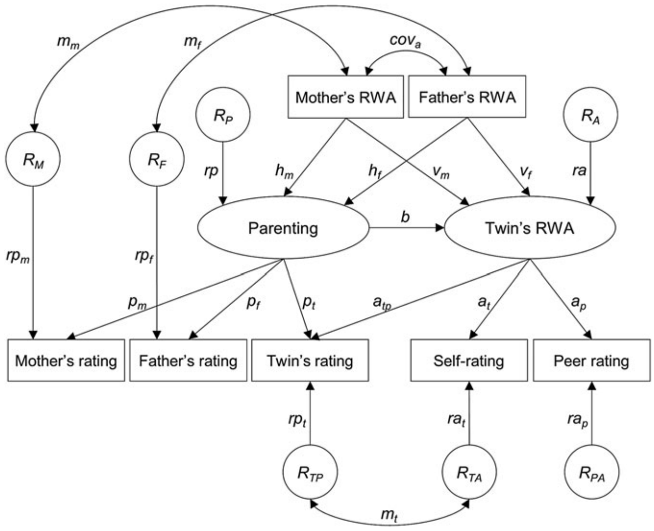

Figure 4. Phenotypic semilatent multitrait-multimethod model including parental RWA. Parenting and the twin's RWA are plotted as latent variables as described in Figure 2. This model also includes mother's and father's self-reports on their own RWA, which is allowed to correlate between them (cov_a). All residual variables (R_M, R_F, R_{TP}, R_{TA}, R_{PA}, R_A, and R_P) are uncorrelated, except within-rater residual components, namely twin's (m_t), mother's (m_m), and father's (m_f) assessments. All variances of exogenous variables and p_m, p_f, a_t as well as a_p are fixed to 1 for model identification and in order to freely estimate all other paths coefficients. For more details on parametrization and model specification, see text.

Both phenotypic model analyses were first run separately for each twin of a pair. Then, we constrained the model parameters to be equal across twin siblings as quasi-cross-validation of the estimated effects. Furthermore, the full models were compared with different reduced models by fixing parameters that turned out to be non-significant in the full model. The overall model fit was evaluated by the RMSEA and CFI. Nested model comparisons were based on the χ^2-difference tests.

RESULTS

Genetically informative regression analyses

The best fitting models for the association between each parenting dimension and RWA within twins' self-reports and across rater perspectives are reported in Tables 3 and 4, and standardized estimates are reported in Figures 5 and 6. For the other three model results, see Supporting Information B. All models provided good to excellent model fits. Model estimates yielded significant genetic and nonshared environmental contributions to the variance in self-reported RWA and significant but smaller genetic and larger nonshared environmental contributions as well as significant shared environmental influences to the variance in peer-reported RWA.

Responsiveness and RWA

The phenotypic regression model yielded a significant positive prediction of twin's RWA by responsiveness for self-reports (b = .163, SE = .038, p < .001) and peer reports (b = .179, SE = .042, p < .001), not confirming Hypothesis 1.1. For the association between twins' RWA and responsiveness, the latent A regression model provided the best model fit (for self-reports: χ^2 = 16.355, df = 12,

Table 3. *Results for the best fitting model of the association between retrospectively assessed responsiveness as predictor variable and self- and peer-rated RWA as outcome variable: Latent A regression model*

Model paths		Self-report				Peer report			
		Estimate	SE	p	R^2	Estimate	SE	p	R^2
Responsiveness									
a_P:	Additive genetic effects	**.547**	.104	< .001	.311	.429	.253	.090	.191
c_P:	Shared environmental effects	**.556**	.093	< .001	.321	**.560**	.107	< .001	.325
e_P:	Nonshared environmental effects	**.503**	.024	< .001	.263	**.504**	.025	< .001	.263
b_A:	$A_{\mathrm{RWA}} \rightarrow$ Responsiveness	**.317**	.092	< .001	.105	.462	.277	.096	.221
RWA									
a:	Additive genetic effects	**.858**	.102	< .001	.713	**.477**	.230	.038	.215
c:	Shared environmental effects	.000	$.359 \times 10^7$	> .999	.000	**.548**	.175	.002	.298
e:	Nonshared environmental effects	**.546**	.026	< .001	.297	**.700**	.036	< .001	.486
b_C:	$C_{\mathrm{Responsiveness}} \rightarrow$ RWA	.000				.000			
b:	Responsiveness → RWA	−.060	.074	.415	.003	−.024	.103	.815	.001

Note. Estimates reflect unstandardized path coefficients. Parameter b_C was fixed to zero. Significant values are bold-faced.

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Table 4. *Results for the best fitting model of the association between retrospectively assessed demandingness as predictor variable and self- and peer-rated RWA as outcome variable: Phenotypic regression model*

Model paths		Self-report				Peer report			
		Estimate	*SE*	*p*	R^2	Estimate	*SE*	*p*	R^2
Demandingness									
a_P:	Additive genetic effects	**.545**	.131	< .001	.301	**.547**	.131	< .001	.305
c_P:	Shared environmental effects	**.529**	.123	< .001	.284	**.525**	.124	< .001	.280
e_P:	Nonshared environmental effects	**.639**	.031	< .001	.415	**.640**	.031	< .001	.415
b_A:	$A_{\mathrm{RWA}} \rightarrow$ Demandingness	.000				.000			
RWA									
a:	Additive genetic effects	**.832**	.102	< .001	.687	**.476**	.232	.041	.227
c:	Shared environmental effects	.000	$.417 \times 10^6$	> .999	.000	**.523**	.188	.005	.274
e:	Nonshared environmental effects	**.537**	.025	< .001	.287	**.704**	.037	< .001	.496
b_C:	$C_{\mathrm{Demandingness}} \rightarrow$ RWA	.000				.000			
b:	Demandingness → RWA	**.161**	.035	< .001	.026	.069	.040	.088	.005

Note. Estimates reflect unstandardized path coefficients. Parameters b_A and b_C were fixed to zero. Significant values are bold-faced.

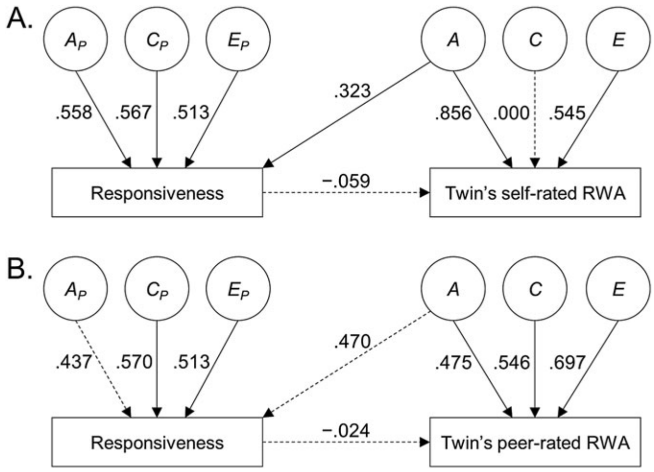

Figure 5. Results for the latent *A* model of the regression of (A) self-rated, respectively (B) peer-rated RWA on responsiveness. Parameters indicate standardized path coefficients. Dashed lines show nonsignificant paths ($p \geq .05$). For parameter descriptions, see Figure 2.

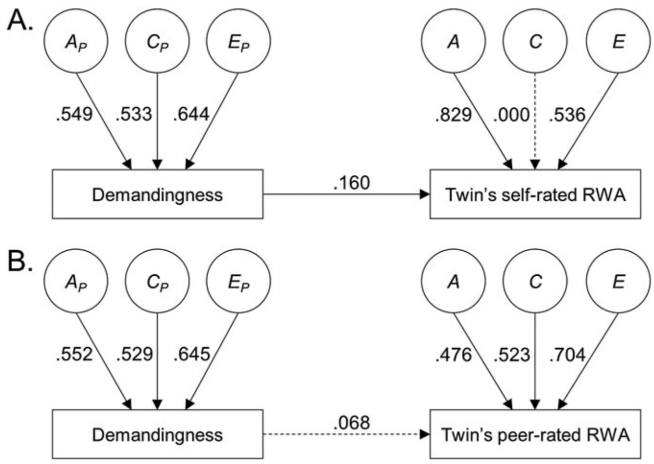

Figure 6. Results for the phenotypic model of the regression of (A) self-rated, respectively (B) peer-rated RWA on demandingness. Parameters indicate standardized path coefficients. Dashed lines show nonsignificant paths ($p \geq .05$). For parameter descriptions, see Figure 2.

p = .175, CFI = .989, RMSEA = .030, ECVI = .123; for peer reports: χ^2 = 13.956, df = 12, p = .304, CFI = .994, RMSEA = .020, ECVI = .117). It yielded a significantly better model fit compared to the phenotypic regression model ($\Delta\chi^2$ = 11.279, Δdf = 1, p = .001 for self-reports, and $\Delta\chi^2$ = 4.270, Δdf = 1, p = .039 for peer reports) and

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did not yield a significantly worse model fit compared to the latent $A + C$ regression model ($\Delta\chi^2 = 0.672$, $\Delta df = 1$, $p = .412$ for self-reports, and $\Delta\chi^2 = 0.007$, $\Delta df = 1$, $p = .935$ for peer reports). Moreover, the model showed a higher CFI as well as a smaller ECVI than the latent C regression model (self-reports: CFI = .989 vs. .981; ECVI = .123 vs. .132; peer reports: CFI = .994 vs. 988; ECVI = .117 vs. 122). Hence, in line with Hypothesis 2, we found that genetic factors accounted for the association between responsiveness and RWA. That is, twins higher on RWA due to genetic sources also reported a higher level of experienced responsiveness.

Demandingness and RWA

The phenotypic regression model yielded a significant positive prediction of twin's RWA by demandingness for self-reports ($b = .161$, $SE = .035$, $p < .001$) and a non-significant positive prediction for peer reports ($b = .069$, $SE = .040$, $p = .088$), confirming Hypothesis 1.2. Since Hypothesis 1.2 was directional ($b > 0$), the effect can be treated as one-tailed significant ($p = .044$). For the association between the twins' RWA and demandingness, the phenotypic regression model represented the best fitting model (for self-reports: $\chi^2 = 24.012$, $df = 13$, $p = .031$, CFI = .963, RMSEA = .046, ECVI = .138; for peer reports: $\chi^2 = 15.414$, $df = 13$, $p = .282$, CFI = .987, RMSEA = .022, ECVI = .116). All three more complex models did not provide significantly better model fits ($A + C$ regression model, $\Delta\chi^2 = 0.331$, $\Delta df = 2$, $p = .847$ for self-reports, and $\Delta\chi^2 = 1.711$, $\Delta df = 2$, $p = .425$ for peer reports; latent A regression model, $\Delta\chi^2 = 0.093$, $\Delta df = 1$, $p = .761$ for self-reports, and $\Delta\chi^2 = 1.279$, $\Delta df = 1$, $p = .258$ for peer reports; latent C regression model, $\Delta\chi^2 = 0.004.$, $\Delta df = 1$, $p = .949$ for self-reports, and $\Delta\chi^2 = 1.711$, $\Delta df = 1$, $p = .191$ for peer reports). In consequence, contrary to Hypotheses 2 and 3, twin differences in retrospectively reported demandingness were associated with twin differences in twins' self-reports on RWA beyond genetic and shared environmental effects, indicating a small but significant quasi-causal positive effect from demandingness on RWA. That is, twins who reported experiences of more demandingness compared to their twin siblings showed higher levels of RWA than their co-twins.

Phenotypic semilatent multitrait-multimethod analyses

Responsiveness and RWA

Both the model not including parental RWA and the model including parental RWA were successfully cross-validated, as reflected by no significantly worse fit of the models upon the assumption of the same effects for both twin siblings (for the model not including parental RWA: $\Delta\chi^2 = 6.291$, $\Delta df = 8$, $p = .615$; for the model including parental RWA: $\Delta\chi^2 = 8.139$, $\Delta df = 13$, $p = .834$). As a consequence, results for model parameters constrained to be equal across twins are reported in the following sections. See Supporting Information C for results for each twin sibling and Supporting Information D for correlations between offspring's and parents' ratings of parenting and offspring's self-assessed and peer-assessed RWA and parental RWA. See Table 5 for unstandardized model parameter estimates and Figures 7A and 7B for standardized estimates of the model not taking parental RWA into account and the model including parental RWA. Both models showed an excellent overall model fit (Figure 7A: $\chi^2 = 9.945$, $df = 18$, $p = .934$, CFI = 1.000, RMSEA = .000; Figure 7B: $\chi^2 = 18.031$, $df = 42$, $p > .999$, CFI = 1.000, RMSEA = .000).

For both models, similar to the results of the genetically informative regression models, we found the twins' RWA to be significantly positively predicted by responsiveness ($b = .189$–$.271$, $SE = .048$–$.067$, $p < .001$). Regarding global rater effects, such as acquiescence or social desirability, the analyses did not yield a significant residual covariance between the twins' reports on responsiveness and their RWA rating ($m_t = .086$, $SE = .060$, $p = .150$) for the model not including parental RWA, but did yield it for the model including parental RWA ($m_t = .113$, $SE = .057$, $p = .048$). In any case, correlations were rather small. Considering the specific rater effect of twins' RWA on twins' responsiveness rating ($a_{tp} = .099$, $SE = .071$, $p = .164$, and $a_{tp} = .095$, $SE = .068$, $p = .167$), we did not find a significant association for either model. Thus, specific response biases due to twin's RWA did not seem to have an influence on the twin's assessment of parental responsiveness. Regarding the association between parental RWA and the residual variance in parents' own responsiveness assessment, we did not find a significant association for the twins' mothers ($m_m = .074$, $SE = .051$, $p = .144$), but did find it for the twins' fathers ($m_f = .130$, $SE = .050$, $p = .009$), suggesting that global response biases and potentially specific response biases due to the parent's RWA had an influence on both paternal assessments. However, again these correlations were rather small.

For the model not including parental RWA, the model fit did not significantly worsen when effects of either global or specific response biases were excluded (global: $\Delta\chi^2 = 1.901$, $\Delta df = 1$, $p = .168$; specific: $\Delta\chi^2 = 1.647$, $\Delta df = 1$, $p = .199$), but upon exclusion of both effects ($\Delta\chi^2 = 6.297$, $\Delta df = 2$, $p = .043$). For the model including parental RWA, the exclusion of effects due to the influence of twins' RWA on twins' responsiveness rating (i.e. specific response biases) did not worsen the model fit ($\Delta\chi^2 = 1.582$, $\Delta df = 1$, $p = .209$), but the exclusion of effects due to parents' and twins' global response biases did ($\Delta\chi^2 = 14.936$, $\Delta df = 2$, $p = .002$). Thus, even though the effects were rather small, response biases have to be taken into account when analysing the regression of RWA on retrospectively reported responsiveness, because they artificially act to increase positive correlations, inflating positive associations between parental responsiveness and RWA to some degree. However, their general contribution was rather small, and the latent regression of twin's RWA on responsiveness remained statistically significant and moderate in effect size ($\beta = .252$ and $\beta = .233$; see Figures 7A and 7B).

The analyses including parents' RWA self-reports revealed significant vertical effects of the parental RWA on offspring's RWA; both the maternal and paternal RWA positively predicted the offspring's RWA, with father's RWA to a lesser degree. In line with a vertical genetic

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Table 5. *Results of the phenotypic semilatent MTMM analyses for responsiveness and RWA*

Model path				Not including parental RWA			Including parental RWA		
				Estimate	*SE*	*p*	Estimate	*SE*	*p*
b:	Responsiveness	→	Twin's RWA	**.189**	.048	< .001	**.271**	.067	< .001
Horizontal and vertical effects of parent's RWA									
h_m:	Mother's RWA	→	Responsiveness				.078	.050	.118
h_f:	Father's RWA	→	Responsiveness				**−.125**	.049	.011
v_m:	Mother's RWA	→	Twin's (latent) RWA				**.344**	.040	< .001
v_f:	Father's RWA	→	Twin's (latent) RWA				**.131**	.043	.002
cov_a:	Mother's RWA	↔	Father's RWA				**.529**	.030	< .001
Effect of twin's RWA on twin's responsiveness rating									
a_{tp}:	Twin's RWA	→	Twin's responsiveness rating	.099	.071	.164	.095	.068	.167
Covariance between self-rating residuals									
m_t:	Twin's RWA	↔	Twin's responsiveness rating	.086	.060	.150	**.113**	.057	.048
m_m:	Mother's RWA	↔	Mother's responsiveness rating				.074	.051	.144
m_f:	Father's RWA	↔	Father's responsiveness rating				**.130**	.050	.009
Factor loadings of twins' RWA self- and peer reports on latent twin's RWA									
a_t:	Twin's RWA	→	Self-rated RWA	1.000			1.000		
a_p:	Twin's RWA	→	Peer-rated RWA	1.000			1.000		
RWA measures' residual variances									
ra_t:	Residual variance of self-rated RWA			**.659**	.028	< .001	**.652**	.026	< .001
ra_p:	Residual variance of peer-rated RWA			**.655**	.028	< .001	**.661**	.026	< .001
ra:	Residual variance of twin's (latent) RWA			**.729**	.028	< .001	**.596**	.029	< .001
Factor loadings of mothers', fathers', and twins' responsiveness rating on latent responsiveness									
p_t:	Responsiveness	→	Twin's rating	**.589**	.055	< .001	**.944**	.106	< .001
p_m:	Responsiveness	→	Mother's rating	**.683**	.057	< .001	1.000		
p_f:	Responsiveness	→	Father's rating	**.624**	.057	< .001	1.000		
Responsiveness measures' residual variances									
rp_t:	Residual variance of twin's responsiveness rating			**.792**	.036	< .001	**.776**	.037	< .001
rpm:	Residual variance of mother's responsiveness rating			**.756**	.045	< .001	**.778**	.035	< .001
rp_f:	Residual variance of father's responsiveness rating			**.811**	.040	< .001	**.812**	.036	< .001
rp:	Residual variance of (latent) responsiveness						**.640**	.039	< .001

Note. Estimates are unstandardized path coefficients. Significant path coefficients are bold-faced. Parameters a_t and a_p were fixed to 1; parameters p_m and p_f were fixed to 1 for the model considering parental RWA.

transmission from parents to offspring (c.f. Tables 3 and 4), parents' self-reported RWA accounted for about 33% of individual differences in offspring's RWA (see Figures 5 and 7B: $v_m^2 + v_f^2 + 2 \times v_m \times v_f \times cov_a = .457^2 + .175^2 + 2 \times .457 \times .175 \times .529 = .325$).

Concerning indications for horizontal effects, the maternal RWA did not have a significant influence on responsiveness ($h_m = .078$, $SE = .050$, $p = .118$), while paternal RWA had a significant negative influence on responsiveness ($h_f = -.125$, $SE = .049$, $p = .011$). The latter indicated that fathers high on RWA *showed* lower levels of (latent) responsiveness, contrasting the positive association between fathers' RWA scores and residual variance in paternal responsiveness rating, indicating that fathers high on RWA *reported* higher levels of responsiveness. However, the horizontal effects of mothers' and fathers' RWA on parental responsiveness were generally small, accounting for less than 3% of the variance in responsiveness (see Figures 5 and 7B: $h_m^2 + h_f^2 + 2 \times h_m \times h_f \times cov_a = .120^2 + [-.193]^2 + 2 \times .120 \times [-.193] \times .529 = .027$). Hence, given the complete genetic confounding of the association between responsiveness and twins' RWA (see Table 3 and Figure 5A), passive genotype–environment correlation could only account for a small proportion of the association between responsiveness and twin's RWA and tended—if at all—to suppress the positive correlation (see Figures 5 and 7B: $h_m \times v_m + h_f \times v_f + h_m \times cov_a \times v_f + h_f \times cov_a \times v_m = .120 \times .457 + [-.193] \times .175 + .120 \times .529 \times .175 + [-.193] \times .529 \times .457 = -.014$).[5] In sum, the findings pointed towards an alternative explaining mechanism of the positive genetic link between parental responsiveness and offspring's RWA, such as evocative genotype–environment correlation.

Demandingness and RWA

For demandingness, both the model not including parental RWA ($\Delta\chi^2 = 7.977$, $\Delta df = 8$, $p = .436$) and the model including parental RWA ($\Delta\chi^2 = 9.147$, $\Delta df = 13$, $p = .762$) were successfully cross-validated. For estimates of each twin of a pair, see Supporting Information C; for correlations between offspring's and parents' reports on parenting and offspring's

[5]The negative horizontal effect from father's RWA (compared to the non-significant horizontal effect from mother's RWA) on responsiveness indicated diverging and contrasting contributions of specific passive genotype-environment correlations depending on the specific parent. The paternal influence resulted in a negative passive genotype–environment correlation (see Figures 5 and 7B: $h_f \times v_f + h_f \times cov_a \times v_m = [-.193] \times .175 + [-.193] \times .529 \times .457 = -.080$), whereas the maternal influence indicated a positive but non-significant passive genotype–environment correlation (see Figures 5 and 7B: $h_m \times v_m + h_m \times cov_a \times v_f = .120 \times .457 + .120 \times .529 \times .175 = .066$). Thus, the paternal horizontal effect tended to suppress the positive link between responsiveness and twin's RWA, whereas the maternal horizontal effect tended to increase the positive link. However, both contributions were rather small and need to be replicated by future research before drawing definitive conclusions.

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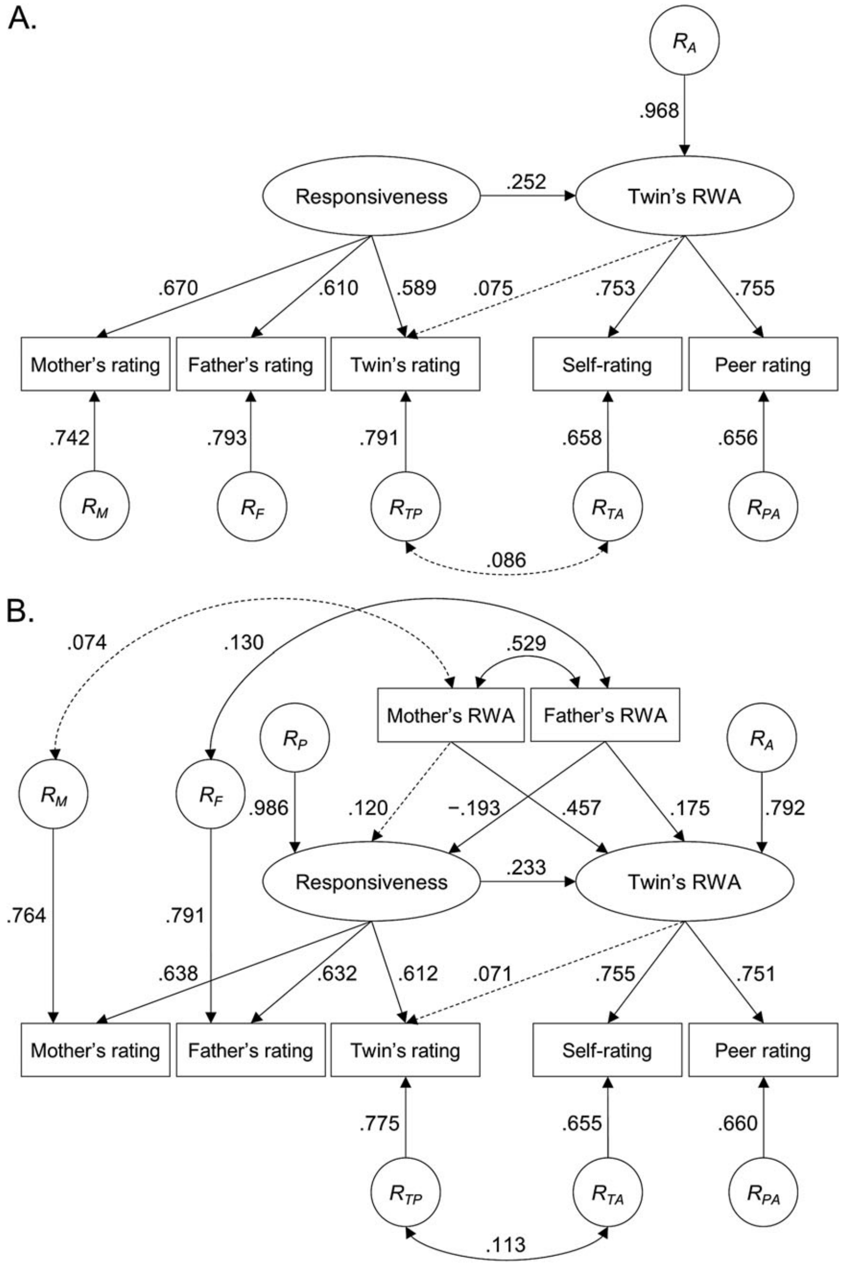

Figure 7. Results of the phenotypic semilatent MTMM analysis for responsiveness (A) without parental RWA and (B) considering parental RWA. Parameters are standardized path coefficients. Dashed lines reflect nonsignificant estimates ($p \geq .05$). For parameter descriptions, see Figures 3 and 4.

self-assessed and peer-assessed RWA and parental RWA, see Supporting Information D. Unstandardized model parameter estimates are reported in Table 6, and standardized estimates for both models are shown in Figures 8A and 8B. The fit of both models was excellent (Figure 8A: $\chi^2 = 15.461$, $df = 18$, $p = .859$, CFI = 1.000, RMSEA = .000; Figure 8B: $\chi^2 = 24.539$, $df = 42$, $p = .986$, CFI = 1.000, RMSEA = .000).

Again, the model fit worsened for both the model not including parental RWA ($\Delta\chi^2 = 6.519$, $\Delta df = 2$, $p = .038$) and the model including parental RWA ($\Delta\chi^2 = 16.627$, $\Delta df = 4$, $p = .002$), when effects due to global and specific response biases were excluded, suggesting some influences of both global and specific response biases. More specifically, the direction of effects indicated that global response tendencies acted to increase within-rater associations between demandingness and RWA ratings. In other words, higher RWA self-ratings came along with higher demandingness ratings. In contrast, specific response biases due to twins' RWA acted to decrease the twins' demandingness rating. In other words, twins higher on RWA *reported* lower levels of demandingness, suppressing a positive association between parental demandingness and twin's RWA within self-reports. Hence, global rater biases acted to increase positive correlations, whereas specific rater biases acted to decrease positive correlations. Taking the effects due to rater biases into account, the latent regression between demandingness and offspring's RWA was significant and even larger than would be expected on the basis of single rater studies ($\beta = .430$ and $\beta = .160$; see Figures 8A and 8B).

Table 6. *Results of the phenotypic semilatent MTMM analyses for demandingness and RWA*

Model path				Not including parental RWA			Including parental RWA		
				Estimate	*SE*	*p*	Estimate	*SE*	*p*
b:	Demandingness	→	Twin's RWA	**.323**	.047	< .001	**.194**	.094	.039
Horizontal and vertical effects of parent's RWA									
h_m:	Mother's RWA	→	Demandingness				**.183**	.046	< .001
h_f:	Father's RWA	→	Demandingness				**.189**	.046	< .001
v_m:	Mother's RWA	→	Twin's (latent) RWA				**.327**	.043	< .001
v_f:	Father's RWA	→	Twin's (latent) RWA				.065	.046	.153
cov_a:	Mother's RWA	↔	Father's RWA				**.531**	.030	< .001
Effect of twin's latent RWA on twin's demandingness rating									
a_{tp}:	Twin's RWA	→	Twin's demandingness rating	**−.206**	.093	.026	**−.169**	.091	.063
Covariance between self-rating residuals									
m_t:	Twin's RWA	↔	Twin's demandingness rating	**.119**	.060	.046	.107	.059	.067
m_m:	Mother's RWA	↔	Mother's demandingness rating				**.118**	.050	.018
m_f:	Father's RWA	↔	Father's demandingness rating				.093	.050	.066
Factor loadings of twins' RWA self- and peer reports on latent twin's RWA									
a_t:	Twin's RWA	→	Self-rated RWA	1.000			1.000		
a_p:	Twin's RWA	→	Peer-rated RWA	1.000			1.000		
RWA measures' residual variances									
ra_t:	Residual variance of self-rated RWA			**.664**	.027	< .001	**.428**	.034	< .001
ra_p:	Residual variance of peer-rated RWA			**.650**	.028	< .001	**.436**	.035	< .001
ra:	Residual variance of twin's (latent) RWA			**.679**	.032	< .001	**.371**	.034	< .001
Factor loadings of mothers', fathers', and twins' demandingness rating on latent demandingness									
p_t:	Demandingness	→	Twin's rating	**.636**	.071	< .001	1.002	.136	< .001
p_m:	Demandingness	→	Mother's rating	**.689**	.057	< .001	1.000		
p_f:	Demandingness	→	Father's rating	**.595**	.056	< .001	1.000		
Demandingness measures' residual variances									
rp_t:	Residual variance of twin's demandingness rating			**.813**	.040	< .001	**.816**	.037	< .001
rpm:	Residual variance of mother's demandingness rating			**.745**	.046	< .001	**.770**	.044	< .001
rp_f:	Residual variance of father's demandingness rating			**.820**	.038	< .001	**.798**	.035	< .001
rp:	Residual variance of (latent) demandingness						**.524**	.037	< .001

Note. Estimates are unstandardized path coefficients. Significant path coefficients are bold-faced. Parameters a_t and a_p were fixed to 1; Parameters p_m and p_f were fixed to 1 for the model considering parental RWA.

Whereas demandingness positively predicted twins' RWA in both models, the association was found to considerably weaken when parental RWA was taken into account (β = .430 vs. β = .160). In addition to the already mentioned vertical effects from parental RWA on offspring's RWA, we found horizontal effects of the maternal RWA (h_m = .183, SE = .046, p < .001) and the paternal RWA (h_f = .189, SE = .046, p < .001) on demandingness: More right-wing authoritarian parents showed more demandingness. The effect of parents'—in particular the mother's—RWA on both demandingness and the twin's RWA thus partially accounted for the association between twins' RWA and demandingness (see Figures 6 and 8B: $h_m \times v_m + h_f \times v_f + h_m \times cov_a \times v_f + h_f \times cov_a \times v_m = .296 \times .436 + .306 \times .087 + .296 \times .531 \times .087 + .306 \times .531 \times .436 = .240$), indicating that a substantial proportion of the link between parental demandingness and offspring's RWA was driven by parental RWA. This partial explanation by parents' RWA could not be attributed to passive genotype–environment correlation, because the genetically informative regression model analysis yielded a quasi-causal environmental effect from experienced demandingness on RWA: Differential experiences of demandingness acted to increase differences in RWA within twin pairs. That is, even though more right-wing authoritarian parents tended to show more demandingness and tended to have offspring higher on RWA, the association between retrospectively reported demandingness and twin's RWA was effectively environmental.

DISCUSSION

Investigating the influence of differential parenting on differences in RWA using a genetically informative twin family multi-rater design, our analyses yielded heterogeneous implications for both parenting dimensions. We could confirm a genetic contribution to the positive association between twins' retrospectively reported responsiveness and self-reports as well as peer reports on twins' RWA, inconsistent with Hypothesis 1.1, but consistent with Hypothesis 2. In accordance with Hypothesis 3, the link between responsiveness and twins' RWA may reflect evocative genotype–environment correlation, since it was primarily genetically mediated, remained significant after controlling for rater biases, and could only be marginally accounted for by parental RWA. Evocative genotype–environment transaction mechanisms during development may result in stable individual differences in RWA. In contrast, we found a quasi-causal environmental effect of individual differences in retrospectively reported demandingness on individual differences in offspring's current RWA, consistent with Hypothesis 1.2, but inconsistent with Hypothesis 2 and 3.

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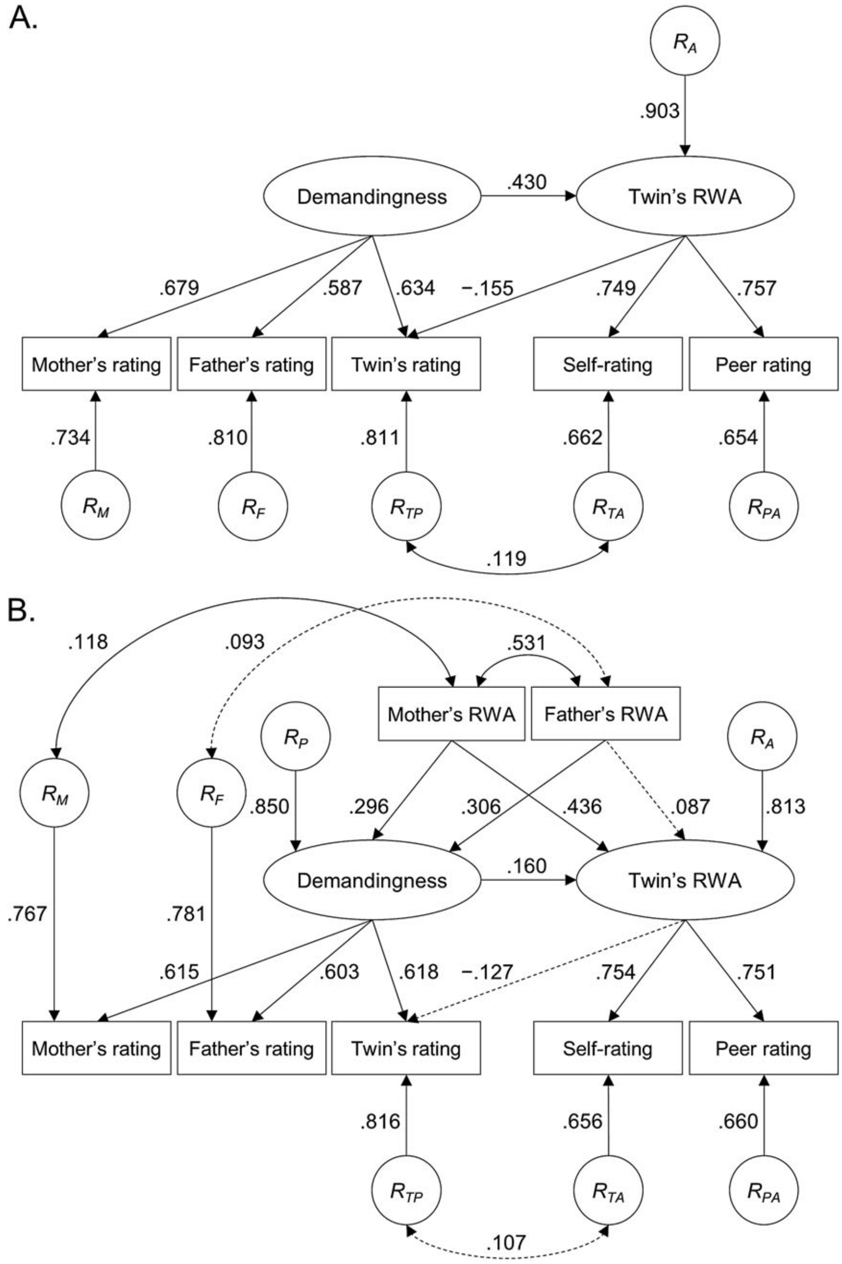

Figure 8. Results of the phenotypic semilatent MTMM analysis for demandingness (A) without parental RWA and (B) considering parental RWA. Parameters are standardized path coefficients. Dashed lines reflect nonsignificant estimates ($p \geq .05$). For parameter descriptions, see Figures 3 and 4.

Responsiveness and RWA: Evocative genotype–environment correlation

Although we found some evidence for global response biases such as acquiescence or severity, our analyses indicate that heritable rater biases cannot explain the genetic link between experiences of responsiveness and RWA. Similarly, the analyses yielded little evidence for passive genotype–environment correlation accounting for the positive link between retrospectively perceived parental responsiveness and offspring's RWA. As a consequence, our findings suggest that the positive association was mainly attributable to an evocative genotype–environment correlation. In other words, parents responded more positively to offspring with higher levels of RWA. That is, while the parental RWA did not substantially influence latent responsiveness, the offspring's partly heritable right-wing authoritarian behaviour, for example compliant, conforming behaviour concerning rule adherence, could have been rewarded with more responsive parental behaviour; or conversely, displayed disobedience may have led to more conflicts and less emotional warmth towards the offspring. These individual differences in reactive parental responsiveness may have contributed to the enhancement of initial genetically based individual differences in RWA. This interpretation is in line with recent molecular genetic findings on the existence of evocative genotype–environment correlation in the context of parenting behaviour (e.g. Hajal et al., 2015; Kopala-Sibley et al., 2017; Pener-Tessler et al., 2013). For example, Pener-Tessler et al. (2013) showed for boys

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that the genotype of Serotonin Transporter Linked Polymorphic Region (5-HTTLPR), a polymorphic region in the gene that encodes the serotonin transporter, affected the level of positive parental treatment, partly mediated through the boys' self-control.

Consistent with previous research implementing offspring's and parents' ratings on responsiveness and related parenting constructs (e.g. Hur & Bouchard, 1995; Kendler, 1996; Plomin, McClearn, Pedersen, Nesselroade, & Bergeman, 1989; Rowe, 1983; for meta-analyses, see Avinun & Knafo, 2014; Kendler & Baker, 2007; Klahr & Burt, 2014), we found responsiveness to be moderately genetically influenced. In a study taking parental ratings, twins' and co-twins' ratings of the twins' parenting into account, Kendler (1996) concluded that this observation is mainly attributable to identical twin siblings evoking more similar parenting behaviours than fraternal twin siblings, in other words: an evocative genotype–environment correlation. The presence of evocative genotype–environment correlation when investigating responsiveness has been repeatedly reported, especially in early childhood research (see Klahr & Burt, 2014, for a thorough discussion). Thus, responsiveness might be especially susceptible to certain genetically influenced dispositions of the offspring in general. Our study provided further support and extends this picture to individual differences in adult RWA.

Demandingness and RWA

A quasi-causal environmental link

First and foremost, using a genetically informative regression model, we could exclude genetic and environmental factors shared by twins as factors potentially confounding the association between demandingness and offspring's RWA. Accordingly, we found a positive quasi-causal environmental effect of differences between twin siblings in experienced demandingness on differences in twin siblings' RWA. Interestingly, parental RWA partially accounted for the association, as revealed by the semilatent multi-rater model analyses. Against the background of the findings from the genetically informative analyses, this cannot be explained by genotype–environment correlation, but by nonshared experiences and phenotype-environment correlation.

The semilatent MTMM analyses yielded some contributions of global rater biases in the form of within-rater correlations that acted to artificially increase single-rater correlations due to acquiescence or other response styles, and specific rater biases in the form of negative correlations between perceived parenting and RWA due to the actual outcome characteristic. That is, being right-wing authoritarian resulted in retrospective reports of lower parental demandingness, suppressing positive correlations between experienced demandingness and RWA. This finding supports the idea that offspring high on RWA would probably not cast their parents in a negative light, since parents represent authorities, which are positively evaluated by individuals high on RWA (Duriez et al., 2007).

Parenting and parental RWA as effectively nonshared experiences

We found the association between parental demandingness and offspring's RWA to be partly attributable to mothers' and fathers' RWA. Parents high on RWA generally showed more demanding behaviours, which is plausible in light of the held values of social conformity and obedience. In contrast, more right-wing authoritarian adult children reported less experienced demandingness, which alludes to a possible relativization or misremembering of their parenting as a consequence of their inclination to characterize authority figures such as their parents in a favourable light. In addition, their individual experiences as parents as well as the peer environment in adulthood primarily not shared by adult twins might have influenced the interpretation of certain parental behaviours as less or more demanding. In line with this, Duckitt (2001) argued in his dual process model that a punitive (vs. tolerant) parental socialization would lead to a personality disposition inclined to be socially conforming, resulting in a heightened sensitivity to conformity violations posing a threat to societal structures. Both the disposition and the sensitivity would lead to a salience of the motivational goal of security and social control and culminate in heightened RWA.

Other nonshared environmental influences

It should be noted that the link between parental demandingness and RWA might be attributable to third variables not shared between twin siblings affecting both differences in perceptions of parental demandingness and differences in offspring's RWA, for example peer influences. Fuligni and Eccles (1993) reported a negative relationship between perceived parental strictness and monitoring and extreme peer orientation. This might not only affect the development of sociopolitical attitudes, but a higher conformity with one's peers might also lead to noncompliance with parental expectations, rules, and norms, potentially further increasing parental demandingness. Altemeyer (1988) reported a significant correlation between close friends' RWA ($r = .31$), indicating influences due to the interaction (i.e. selection and socialization) with peers. Yet, to what extent peer socialization affects the development of personality traits in comparison to and interplay with parental socialization is controversially discussed (e.g. Harris, 1995; Vandell, 2000).

Evocative phenotype-environment correlation

A number of studies applying a MZ twin differences design investigated the association between differences in reported and/or observed parenting and differences in the children's behaviour (e.g. Asbury, Dunn, Pike, & Plomin, 2003; Mullineaux, Deater-Deckard, Petrill, & Thompson, 2009). For example, Mullineaux et al. (2009) conducted a multi-rater study on the association between maternal parenting and children's problematic and adaptive behaviours. They found a positive bidirectional association between changes in maternal authoritarian parenting and changes in children's non-compliance to maternal verbalizations. In addition, they reported a positive bidirectional association between changes in maternal authoritative parenting and children's autonomy, attentiveness, and engagement in the task. Asbury et al.

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(2003) found differences in parental discipline to account for 5% of the variance for conduct problems that varied extensively between twins. Cross-lagged twin models also reflected the bidirectional nature of the association between parenting and offspring's outcomes, for example for parental negativity and offspring's antisocial behaviour (e.g. Burt, McGue, Krueger, & Iacono, 2005; Larsson, Viding, Rijsdijk, & Plomin, 2008). Thus, offspring's idiosyncratic behaviours incongruent with parental esteem of obedience and conformity may evoke a more demanding behaviour —especially in parents high on RWA—which more strongly reinforces their offspring's obedient and conforming attitudes relative to their other offspring. As a consequence, small twin differences may increase over time.

Limitations and future outlook

While our multi-rater twin design exhibits a number of strengths and our results will hopefully generate new intriguing questions, several limitations should be mentioned that also point to directions for future research. First, drawing on multiple perspectives broadens the analyses, allows for more far-reaching interpretations of certain complex associations, and is beneficial for research subjects in which self-report measures might considerably bias the relevant psychological constructs, for example the association between demandingness and RWA. Multi-generational studies will be helpful to further illuminate dynamics between parental dispositions, experienced contextual characteristics, and offspring's dispositional and behavioural outcomes. The investigation of both parenting dimensions disentangled from each other as opposed to a categorical manner might help to overcome the lack of a found evocative genotype–environment correlation for experienced warmth in observational studies (Avinun & Knafo, 2014).

Second, as Klahr and Burt (2014) discussed, the implementation of different parenting measures may result in rather discrepant results. We decided to shorten an existing questionnaire in favour of a narrower construct of parenting. The development of a balanced measure for both parenting dimensions is statistically advisable, especially one in which strict and harsh demandingness is measured separately, as this differentiation might have distinct dispositional outcomes (e.g. Duckitt, 2001). In addition, scale content differed slightly between offspring's and parents' version, since parents did not assess their spouse's parenting. Thus, we latently modelled parenting as a more global family environmental component that is agreed upon by all family members, as opposed to the sum of agreements on maternal, paternal, and parent-unspecific parenting. On one hand, this might be advantageous in the context of this study, since the impact of parent-related effects is hard to determine when specific aspects, for example time spent together, cannot be taken into account. On the other hand, it might be more worthwhile to investigate parent-related effects, which should be investigated in the future (see below). In addition, this might have led to additional valid variance not considered for the association between parenting and offspring's RWA.

Third, we captured offspring's RWA in adulthood and parenting as retrospective measure. Even though the found phenotypic links are in line with studies capturing parenting and offspring's behaviour in childhood and adolescence (Duriez et al., 2007), the retrospective perspective might be biased by for example 'softening' or selective remembrance (see above), consequently diminishing the 'true' link between parenting and RWA in our study, and additionally might not capture critical age-specific consolidating processes predetermining future remembrance mechanisms. Yet, Avinun and Knafo (2014) discussed that retrospective parenting assessments might be advantageous in the sense that they capture more general parenting behaviour assessments as opposed to contemporaneous accounts that may be subject to recurrent fluctuations and prevailing conflicts. This would explain why heritability estimates are smaller (Klahr & Burt, 2014) when parenting is reported by children and adolescents.

Fourth, our data, albeit genetically informed and including multiple rater perspectives, thus allowing to test phenotypic associations for quasi-causality in terms of non-confoundedness and to explore diverse explanations, were ultimately cross-sectional, which does not allow for definitive implications of causality. Since the parenting style—among others—underlies the influence of the offspring's behaviour (Klahr & Burt, 2014) and even the offspring's attitudes (e.g. Degner & Dalege, 2013), longitudinal studies can shed more light upon the interaction of parenting and attitude or, more generally, personality development—especially with regard to the dynamic nature of evocative phenotype–environment and genotype–environment correlations.

Fifth, the relatively small sample size and the concomitant statistical power led to analytical restrictions. We did not combine the genetically informative regression model and the semilatent MTMM model into one model analysis —primarily because parents did not rate their parenting for each twin sibling separately, thus not allowing for a twin-difference perspective, but also—due to the lack of statistical power for such complex model analyses. This is also why we decided not to control for a potential type 1 error inflation. In addition, we could not analyse the impact of offspring's sex. The investigation of within-sex and cross-sex associations might offer an even more multifarious pattern, as has been indicated by previous research (e.g. Klahr & Burt, 2014; Laible & Carlo, 2004; Paulson & Sputa, 1996; Russell et al., 1998). For instance, differential effects of mothers' and fathers' RWA on the association between parenting and offspring's RWA might depend on offspring's sex. Moreover, regarding retrospective child reports, Avinun and Knafo (2014) reported different genetic and environmental contributions depending on the parent's sex, with maternal parenting being more genetically influenced and attributable to nonshared environmental factors and paternal parenting being more affected by shared environmental factors. This difference might indicate differential mechanisms involving parent–offspring interactions and different links between parental and offspring's trait, as indicated by our phenotypic MTMM analyses, and should be illuminated by future investigations.

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Finally, we relied on a Western sample. Since the impact of different parenting behaviours and parenting itself might have different effects on offspring's outcomes depending on the socio-cultural context (Putnick et al., 2012; Rudy & Grusec, 2001; Sorkhabi, 2005), future research should focus on the cultural influence on the interplay of parenting and RWA.

Conclusion

The applied design in the current study helped to approximate a quasi-causal inference in terms of non-confoundedness of the association between differential parenting and RWA. We tested for potentially underlying factors confounding the association in the form of a genetic and shared environmental factors and subsequently examined the found association for more in-depth explanations, for example common method biases in terms of global and specific rater biases, passive or evocative genotype–environment correlations.

We found a positive association between retrospectively reported responsiveness and RWA to be completely attributable to common genetic factors, which reflected neither heritable rater biases nor passive genotype–environment correlation to a substantial degree, pointing to evocative genotype–environment correlation as explanation: More right-wing authoritarian, in other words more compliant and obedient, offspring elicited more responsive behaviours from their parents. Moreover, we found a positive association between retrospectively reported demandingness and RWA unconfounded by genetic factors and consequently quasi-causally environmental: Twin siblings who experienced more demandingness than their co-twins showed higher levels of RWA.

Undoubtedly, the 'true' impact of family environments has engaged researchers for decades. Findings showing that every trait is heritable and that theoretically shared environmental factors are negligible do not tell the whole story, especially considering genotype–environment interplay and interindividually different experiences. Disentangling genetic effects and identifying possibly idiosyncratic experiences within the 'shared' environment between siblings is vital in order to illuminate the aetiology of human complex traits, such as ideological attitudes. The current study highlights the use of genetically informative, multi-rater twin family designs—in particular, when investigating effects of measured family environments on psychological outcomes of the offspring. Such complex and multifaceted constructs require equal complexity in design and analyses. As Turkheimer and Waldron (2000) put it:

> The limitations of our existing social scientific methodologies ought not provoke us to wish that human behavior were simpler than we know it to be; instead they should provoke us to search for methodologies that are adequate to the task of understanding the exquisite complexity of human development. (p. 93)

SUPPORTING INFORMATION

Additional Supporting Information may be found online in the supporting information tab for this article.

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