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The Effects of Sibling Relationships on Social Adjustment Among Japanese Twins Compared With Singletons

Mari Nozaki,[1] Keiko K. Fujisawa,[2] Juko Ando,[2] and Toshikazu Hasegawa[1]
[1] *Department of Cognitive and Behavioral Science, Graduate School of Arts and Sciences, The University of Tokyo, Tokyo, Japan*
[2] *Department of Education, Faculty of Letters, Keio University, Tokyo, Japan*

This study examined the link between sibling relationships and children's social adjustment by comparing twin siblings and siblings with different ages (singleton siblings), and clarified the role of reciprocity in sibling relationships on children's social development. Mothers of 58 monozygotic twin pairs, 48 dizygotic twin pairs, and 86 singleton sibling pairs reported their children's sibling relationships and social adjustment. This study showed that the effects of sibling relationships on the prosocial behaviors and conduct problems of each child are stronger for twins than for singleton siblings. Moreover, positivity toward one's sibling increased peer problems only among monozygotic twins. The opposite tendency was present among dizygotic twins and singleton siblings. This study suggests the importance for children's social development of having many interactions with siblings and establishing reciprocity in sibling relationships. Moreover, our results suggest that the quality of sibling relationships among monozygotic twins may be different from those among dizygotic twins and singleton siblings.

Keywords: Twins, singletons, sibling relationships, prosocial behaviors, conduct problems, peer problems

Siblings spend a great deal of time together; by middle childhood, the time spent with siblings outstrips that spent with parents (McHale & Crouter, 1996). Sibling relationships in early childhood affect their social development (Dunn & McGuire, 1992; Jenkins & Dunn, 2009), and many studies have shown a link between sibling relationships and children's social adjustment (see Brody, 1998 for a review). According to previous studies in which the participants were siblings of different ages (hereafter, singleton siblings), emotional support and social learning provided important benefits for children's social adjustment. Previous studies have found that emotional support from a sibling is associated with positive peer relationships and promotes the development of children's social adjustment (Lamarche et al., 2006; Pike et al., 2005; Rinaldi & Howe, 1998). In addition, Hughes and Leekam (2004) showed that social learning from a sibling promotes the development of social skills. Younger siblings tend to observe, imitate, and seek assistance from their older siblings, and older siblings, in turn, teach younger siblings how to play, develop skills, and use toys (Azmitia & Hesser, 1993).

Dunn (1983) noted that sibling interaction is composed of two factors: complementarity and reciprocity. Complementarity refers to hierarchical interactions characterized by sibling caregiving, teaching, and attachment, which resemble parent-child relationships. Reciprocity, on the other hand, refers to egalitarian interactions characterized by playing together and sharing interests, as would be found in typical peer interactions (Hinde, 1979). Most previous studies investigating the link between sibling relationships and children's social adjustment have focused on the aspect of complementarity in sibling relationships (e.g., emotional support and social learning). In addition, Ruffman et al. (1998) suggested that complementarity between siblings is an important factor in the promotion of children's social

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ADDRESS FOR CORRESPONDENCE: Mari Nozaki, Department of Cognitive and Behavioral Science, Graduate School of Arts and Sciences, The University of Tokyo, 3-8-1 Komaba, Meguro-ku, Tokyo 153-8902, Japan. E-mail: mari@darwin.c.u-tokyo.ac.jp

development. However, less is known about the role of the aspect of reciprocity between siblings on children's social adjustment.

Twin siblings are different from singletons in that they have a unique social situation that affects their social experiences and development (Robin & Casati, 1994; Rutter & Redshaw, 1991). Twin siblings spend much more time together than do singleton siblings in early childhood (Thorpe & Danby, 2006). In addition, Howe and Recchia (2009) have suggested that when siblings are closer in age, they have a longer history of shared interaction and perhaps a more reciprocal relationship. Thus, the interactions between twin siblings are likely to be less complementary and more reciprocal than those between singleton siblings. Therefore, it is possible to clarify the role of the aspect of reciprocity between siblings on children's social adjustment by investigating twin siblings, because they have the above characteristics. Notably, with the exception of the study by Bekkhus et al. (2011), the participants in earlier studies were singleton siblings. Bekkhus et al. (2011) reported that conflict and lower levels of warmth between twin siblings in the year prior to beginning school were associated with increased conduct problems within the first year of school, but these factors were not associated with peer problems. However, comparisons between twins and singleton siblings were not conducted in their study. Thus, it is not known whether their findings hold true only for twin siblings or could be generally found among both twins and singleton siblings. Therefore, we need to examine the link between sibling relationships and children's social adjustment by comparing twin siblings and singleton siblings.

The effect of complementarity between siblings (including emotional support and social learning) on children's social adjustment could be weaker among twin siblings than among singleton siblings, because twin siblings maintain less complementarity than do singleton siblings. In contrast, the effect of reciprocity between siblings on children's social development could be stronger among twin siblings than among singleton siblings, because twin siblings typically interact with each other more than singleton siblings. Moreover, monozygotic twins (MZs) may differ from dizygotic twins (DZs) and singleton siblings (hereafter, singletons). Some previous studies have suggested differences in sibling relationships and friendship patterns between MZs and DZs (Segal et al., 1996; Thorpe & Gardner, 2006; Zahn-Waxler et al., 1992). Zahn-Waxler et al. (1992) reported that an MZ twin who was cooperative with a co-twin was less empathic toward peers, whereas a DZ twin who was cooperative with a co-twin was more empathic toward peers. Segal et al. (1996) reported that MZs are less cooperative when paired with an unknown child than are DZs. Moreover, MZs share more friends than DZs (Thorpe & Gardner, 2006). Such differences in social relationships between MZs and DZs may influence children's social development, particularly their social relationships outside of those with their co-twins.

Methods

Participants

The twin participants consisted of 106 mothers of 5-year-old same-sex twins (mean age = 5.24 years, $SD = .15$). There were 58 pairs of MZs (24 boy–boy pairs and 34 girl–girl pairs) and 48 pairs of DZs (22 boy–boy pairs and 26 girl–girl pairs). One of the twins in each pair was randomly designated as Twin 1, and the remaining twin was designated as Twin 2. The twins were recruited from the Tokyo Twin Cohort Project (ToTCoP; Ando et al., 2006). Zygosity was determined using a questionnaire that can estimate zygosity with sufficient accuracy on the basis of physical similarities between twin siblings at around 1 year of age (95.1%; Ooki & Asaka, 2004). The ToTCoP study was approved by the Ethics Committee of the Faculty of Letters, Keio University. Written informed consent was obtained from all participants in the study on twins. The singleton participants consisted of 86 mothers of same-sex singleton siblings (48 boy–boy pairs and 38 girl–girl pairs). These sibling pairs were divided into younger siblings (YSs; mean age = 4.25 years, $SD = .77$) and older siblings (OSs; mean age = 6.95 years, $SD = 1.56$; age gap: mean = 2.70, $SD = 1.09$). They were recruited from among Internet research monitors who had consented to the guidelines and registered with Yahoo! Research or Nikkei Research. The mothers of twins were significantly older than those of singletons ($t(189) = 2.17$, $p < .05$). Therefore, we checked the effect of maternal age on sibling relationships and children's social adjustment by performing regression analysis.

Questionnaires

Sibling relationships. We used the Maternal Interview of Sibling Relationships (MISR; Stocker et al., 1989) to measure sibling relationships. We translated the English version of the MISR into Japanese, and then back-translation to English was completed by a bilingual speaker of English and Japanese. Mothers answered the items of the MISR separately for each child. All items of the MISR were scored on a 6-point Likert Scale ranging from 0 (*almost never*) to 6 (*regularly*). The MISR was composed of two factors: Sibling Positivity (six items; Cronbach's $\alpha = .69$, .80, and .81 for twins, YSs, and OSs, respectively) and Sibling Negativity (3 items; $\alpha = .56$ for all three groups). We used the sum of the six items in the Sibling Positivity factor to represent 'Sibling Positivity of Twin 1 or YS (Posi 1)' or 'Sibling Positivity of Twin 2 or OS (Posi 2)'. Similarly, we also summed the three items in the Sibling Negativity factor to represent 'Sibling Negativity of Twin 1 or YS (Nega 1)' or 'Sibling Negativity of Twin 2 or OS (Nega 2)'.

Children's social adjustment. We used the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997) to measure children's social adjustment. The SDQ is composed of five factors comprised of five items each: Prosocial Behaviors ($\alpha = .73$, .80, and .83 for twins, YSs, and OSs, respectively),

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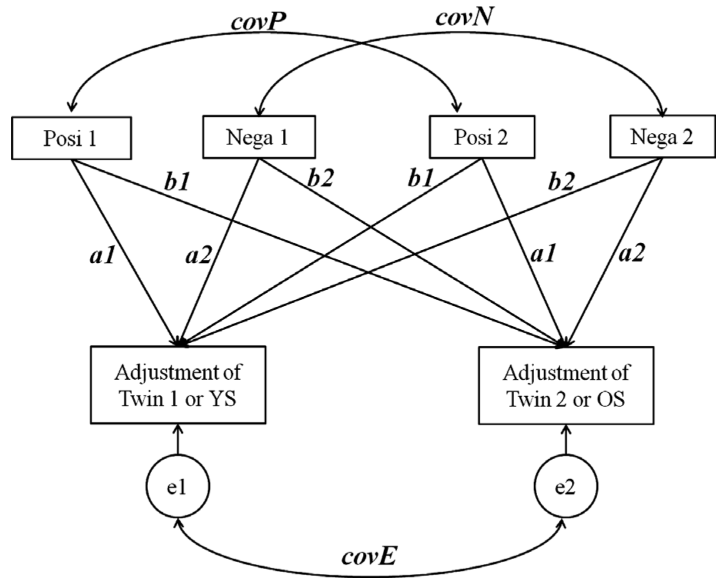

FIGURE 1

The full model for each group.
Note. YS: younger siblings; OS: older siblings; Posi 1: Sibling Positivity of Twin 1 or YS; Posi 2: Sibling Positivity of Twin 2 or OS; Nega 1: Sibling Negativity of Twin 1 or YS; Nega 2: Sibling Negativity of Twin 2 or OS.

Hyperactivity ($\alpha = .77$, .65, and .78), Conduct Problems ($\alpha = .65$, .66, and .66), Emotional Problems ($\alpha = .60$ for all three groups), and Peer Problems ($\alpha = .58$, .53, and .54). Mothers answered the SDQ separately for each child. All items were scored on a 3-point Likert Scale ranging from 1 (*not true*) to 3 (*certainly true*).

Analysis

Because each mother answered questionnaires for two children, the data regarding Twin 1 and Twin 2 or the YS and the OS were not statistically independent. Therefore, it is not appropriate to employ analysis of variance to make between-group comparisons. By using structural equation modeling (SEM), we treat each child as having separate variance and solve the problem of non-independence of the data.

In order to investigate differences in sibling relationships and social adjustment between twin siblings and singleton siblings, we compared the means (M) and variances (V) of each factor in the MISR and the SDQ between MZs, DZs, YSs, and OSs by performing simultaneous path analysis (an SEM method) using the AMOS version 19 software package. We determined the best-fit model by investigating equality constraints between the M and V of six variables: MZs–Twin 1, MZs–Twin 2, DZs–Twin 1, DZs–Twin 2, YSs, and OSs. If we can accurately set equality constraints between some variables, those variables are regarded as equal.

In order to check the possible confounding factors that could interfere with sibling relationships and children's social adjustment, we performed stepwise multiple regression analysis for each factor of the MISR and SDQ. The independent variables were child's sex, child's age, and maternal age.

In order to investigate whether the link between sibling relationships and social adjustment of each child differs between the three groups (MZs, DZs, and singletons) we performed simultaneous path analysis. At first, we determined the best-fit model for each group. Figure 1 shows the full model. The paths from Sibling Positivity to self-adjustment are labeled *a1*; the paths from Sibling Negativity to self-adjustment are labeled *a2*; the paths from Sibling Positivity to adjustment of the other sibling are labeled *b1*; The paths from Sibling Negativity to adjustment of other sibling are labeled *b2*; the covariance between Posi 1 and Posi 2 is labeled *covP*; the covariance between Nega 1 and Nega 2 is labeled *covN*; and the covariance between errors is labeled *covE*. Then, we compared fifteen hypothesized models in which each of the variables *a1*, *a2*, *b1*, and *b2* were either included or excluded; we did not test the model eliminating all four paths. If any covariance was not significant, it was removed from the model. In addition, the hypotheses that *b1* and *b2* would differ between YSs and OSs were tested only among the singletons. Once the best-fit model was determined for each group, we performed a simultaneous analysis of the three groups and investigated the equality constraints between groups. These analyses indicated that neither *a1* nor *a2* were significant in the link between sibling relationships and two factors of SDQ (Hyperactivity and Emotional Problems). Therefore, we report results regarding the effects of sibling relationships on only three factors of SDQ (Prosocial Behaviors, Conduct Problems, and Peer Problems) in the Results section. The results for

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TABLE 1
Estimated Statistics of the MISR and SDQ in the Best-Fit Model

	Estimated means (estimated variances)				
	MZs	DZs	YSs	OSs	Differences in means between groups
MISR					
Sibling Positivity	23.72 (14.26)	22.38 (14.26)	21.06 (23.61)	21.06 (23.61)	MZs > DZs > YSs = OSs
Sibling Negativity	9.60 (8.33)	9.60 (8.33)	8.22 (8.33)	8.22 (8.33)	MZs = DZs > YSs = OSs
SDQ					
Prosocial Behaviors	12.05 (4.46)	12.05 (4.46)	10.34 (6.66)	11.41 (6.66)	MZs = DZs > OSs > YSs
Conduct Problems	7.43 (3.39)	7.96 (3.39)	7.43 (3.39)	7.43 (3.39)	DZs > MZs = YSs = OSs
Peer Problems	6.49 (2.46)	6.49 (2.46)	6.49 (2.46)	6.49 (2.46)	MZs = DZs = YSs = OSs

Note: MZs: monozygotic twins; DZs: dizygotic twins; YSs: younger siblings; OSs: older siblings.

the other two factors of SDQ, Hyperactivity and Emotional Problems, can be provided by the corresponding author of this paper upon request. The model fit was determined on the basis of the non-significance of χ^2 estimates ($p > .05$), a comparative fit index (CFI) of .95 or greater, a root mean squared estimate of approximation (RMSEA) of less than .08, and a value of Akaike's information criterion (AIC) that was as small as possible.

Results

Comparison Between Groups for Each Factor of the MISR and SDQ

In order to investigate differences in sibling relationships and social adjustment between twin siblings and singleton siblings, we compared M and V of each factor of the MISR and the SDQ between MZs, DZs, YSs, and OSs by performing simultaneous path analysis. Table 1 shows the estimated M and V values of the best-fit model and the differences in the M of each factor of the MISR and SDQ between groups. In the best-fit model for Sibling Positivity ($\chi^2 = 5.53$, $df = 8$, $p = .60$, CFI = 1.00, RMSEA = .00, AIC = 21.53), Sibling Positivity among MZs was higher than that among DZs, and that among DZs was higher than that among YSs and OSs. In the best-fit model for Sibling Negativity ($\chi^2 = 6.49$, $df = 9$, $p = .69$, CFI = 1.00, RMSEA = .00, AIC = 18.49), Sibling Negativity among MZs and DZs was higher than that among YSs and OSs. In the best-fit model for Prosocial Behaviors ($\chi^2 = 1.41$, $df = 8$, $p = .99$, CFI = 1.00, RMSEA = .00, AIC = 15.40), the scores representing Prosocial Behaviors among MZs and DZs were higher than those among OSs, and those among MZs, DZs, and OSs were higher than those among YSs. In the best-fit model for Conduct Problems ($\chi^2 = 3.95$, $df = 10$, $p = .95$, CFI = 1.00, RMSEA = .00, AIC = 13.95), the scores representing Conduct Problems among DZs were higher than those among MZs, YSs, and OSs. In the best-fit model for Peer Problems ($\chi^2 = 9.80$, $df = 9$, $p = .36$, CFI = 1.00, RMSEA = .00, AIC = 15.40), there were no statistical differences between MZs, DZs, YSs, and OSs.

TABLE 2
Correlation Matrix of the MISR

		Correlation Coefficient			
		1	2	3	4
1	Twin 1 or YSs Sibling Positivity	–			
2	Twin 1 or YSs Sibling Negativity	.21 −.02 .14			
3	Twin 2 or OSs Sibling Positivity	.72** .69** .75**	.25 .14 .22	–	
4	Twin 2 or OSs Sibling Negativity	.06 .10 .14	.77** .70** .53	.02 .12 .15	–

Note: The values at upper section are the correlation coefficient in MZs; the values at the middle section are in DZs; the values at lower section are in singletons.
**: $p < .01$.

Correlations Involving Each Factor of the MISR for Each Group

Table 2 shows the correlation matrix of the MISR for MZs, DZs, and singletons. Posi 1 and Posi 2 were significantly positively correlated in each of the three groups. Nega 1 and Nega 2 were also significantly positively correlated in each of the three groups. However, Posi 1 and Nega 1, Posi 2 and Nega 2, Posi 1 and Nega 2, and Nega 1 and Posi 2 were not significantly correlated in any of the three groups. Therefore, in the following path analysis, no covariance was hypothesized between the positive and negative factors of the MISR.

Investigation of Confounded Factors in Sibling Relationships and Children's Social Adjustment

In order to check the possible confounding factors that could interfere with sibling relationships and children's social adjustment, we performed stepwise multiple regression analysis. Table 3 shows the results of this analysis. Maternal age and child's age were significant predictors of Sibling Positivity. Child's sex and maternal age were significant predictors of Sibling Negativity. Child's sex was a significant predictor of Prosocial Behaviors. Maternal age was

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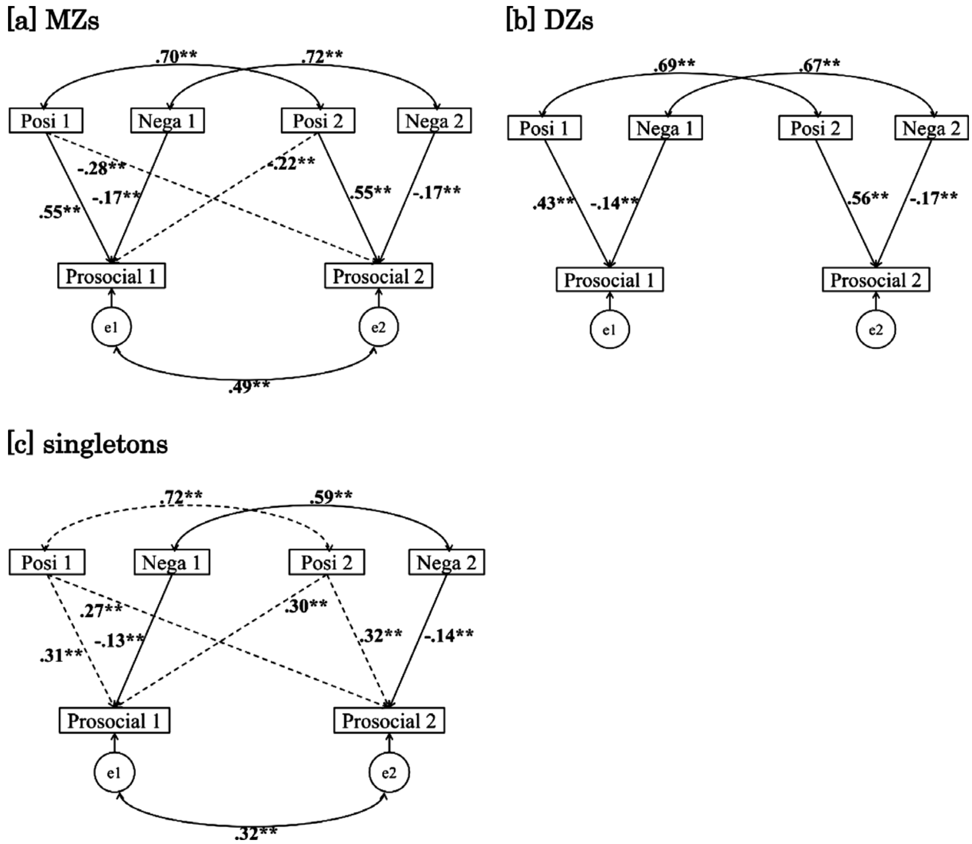

FIGURE 2

The standardized path coefficients and the correlation coefficients of the best fitting model in the relation between sibling relationships and prosocial behaviors.
Note. Solid lines on the same paths between groups mean that we could set equality constraints between the groups. Dotted lines mean that the effects along certain paths differed between groups. Prosocial 1: Prosocial Behaviors of Twin 1 or YS; Prosocial 2: Prosocial Behaviors of Twin 2 or OS.
****: $p < .01$.**

TABLE 3

Summary of Stepwise Multiple Regression Analysis for Sibling Relationships and Adjustment, Examining Confounded Factors

	R^2	F	Child's sex (β)	Child's age (β)	Maternal age (β)
MISR					
Sibling Positivity	.02	4.70		−.10*	.13*
Sibling Negativity	.03	5.23	−.13*		.11*
SDQ					
Prosocial Behaviors	.05	17.85	.21**		
Conduct Problems	.01	4.60			−.11*
Peer Problems	.04	5.46	−.11*	−.13*	−.11*

Note: Child's sex was dummy coded; boys were coded as 1 and girls as 0.
*: $p < .05$, **: $p < .01$.

a significant predictor of Conduct Problems. Child's sex, child's age, and maternal age were significant predictors of Peer Problems. In order to control for these effects, we used the residuals obtained via the stepwise multiple regression analysis in the following path analysis.

The Link Between Sibling Relationships and Children's Social Adjustment

Sibling relationships and prosocial behaviors. The best-fit model among MZs was that in which the paths *a1*, *a2*, *b1*, *covP*, *covN*, and *covE* existed (Figure 2 [a]: $\chi^2 = 9.17$, $df = 9$, $p = .42$, CFI = 1.00, RMSEA = .02, AIC = 45.17). The best-fit model among DZs was that in which the paths *a1, a2, covP,* and *covN* existed (Figure 2 [b]: $\chi^2 = 18.42$, $df = 11$, $p = .07$, CFI = .91, RMSEA = .02, AIC = 50.42). The best-fit model among singletons was that in which paths *a1*, *a2*, *b1, covP*, *covN*, and *covE* existed (Figure 2 [c]: $\chi^2 = 8.18$, $df = 9$, $p = .52$, CFI = 1.00, RMSEA = .00, AIC = 32.18).

Table 4 shows the results of the simultaneous path analysis of sibling relationships and Prosocial Behaviors. Model 4 (RMSEA = .03, AIC = 130.61) yielded the best model fit statistics. Model 4 showed that the path coefficients from Posi 1 to Prosocial Behaviors among Twin 1 and YS (Prosocial 1) and those from Posi 2 to Prosocial Behaviors among Twin 2 and OS (Prosocial 2) were equal between MZs and DZs. It also showed that the path coefficients from Nega 1

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TABLE 4

The Fit Indices and AIC of Each Model of Sibling Relationships and Prosocial Behaviors

	χ^2	*df*	*p*	CFI	RMSEA	AIC
Model 0	35.86	29	.18	.98	.04	139.86
Model 1	64.49	39	.01	.93	.06	148.49
Model 2	50.28	38	.09	.97	.04	136.28
Model 3	45.12	37	.17	.98	.03	133.12
Model 4	**40.61**	**36**	**.27**	**.99**	**.03**	**130.61**
Model 5	38.98	35	.30	.99	.03	130.98

Note: Model 0: All parameters are different between three groups. Model 1: *a1, a2, covP*, and *covN* were equal between three groups. *b1* and *covE* were equal between MZ and singletons. Model 2: The same as Model 1 except that there was no equality constraint on *b1*. Model 3: The same as Model 2 except that *covP* was equal between MZ and DZ. Model 4: The same as Model 3 except that *a1* was equal between MZ and DZ. Model 5: The same as Model 4 except that *covE* was equal between MZ and singletons. The best-fit model is shown in bold font.

TABLE 5

The Fit Indices and AIC of Each Model of Sibling Relationships and Conduct Problems

	χ^2	*df*	*p*	CFI	RMSEA	AIC
Model 0	29.24	27	.35	.99	.02	137.24
Model 1	61.67	38	.01	.93	.06	147.67
Model 2	48.60	37	.10	.96	.04	136.60
Model 3	43.44	36	.18	.98	.03	133.44
Model 4	**34.59**	**35**	**.49**	**1.00**	**.00**	**126.59**
Model 5	32.96	34	.52	1.00	.00	126.96

Note: Model 0: All parameters are different between three groups. Model 1: *a1, a2, b1, covP*, and *covN* were equal between three groups. *covE* were equal between MZ and singletons. Model 2: The same as Model 1 except that *b1* was equal between MZ and DZ. Model 3: The same as Model 2 except that *covP* was equal between MZ and DZ. Model 4: The same as Model 3 except that *a1* was equal between MZ and DZ. Model 5: The same as Model 4 except that *covN* was equal between MZ and DZ.

to Prosocial 1 and from Nega 2 to Prosocial 2 were equal between the three groups. Moreover, the values of *covP* were equal between MZs and DZs, values of *covN* were equal between the three groups, and values of *covE* were equal between MZs and singletons. Figure 2 shows the standardized path coefficients and the correlation coefficients of Model 4. Sibling Positivity increased self-Prosocial Behaviors among all three groups. However, the path coefficients among MZs (.55 and .55; Twin 1 and Twin 2 respectively) and DZs (.43 and .56) were greater than those among singletons (.31 and .32; YSs and OSs, respectively). Sibling Negativity decreased self-Prosocial Behaviors among all three groups to the same extent. In addition, Sibling Positivity decreased Prosocial Behaviors of the other sibling among MZs and DZs to the same extent. On the other hand, these elements increased among singletons.

Sibling relationships and conduct problems. The best-fit model for the MZs was that in which *a1*, *a2*, *b1*, *b2, covP*, *covN*, and *covE* existed (Figure 3a: $\chi^2 = 10.85$, $df = 8$, $p = .21$, CFI = .98, RMSEA = .08, AIC = 36.85). The best-fit model for the DZs was that in which *a1*, *a2*, *b1, covP,* and *covN* existed (Figure 3b: $\chi^2 = 8.44$, $df = 10$, $p = .59$, CFI = 1.00, RMSEA = .00, AIC = 30.44). The best-fit model among singletons was that in which *a1*, *a2 b1, covP*, *covN*, and *covE* existed (Figure 3: $\chi^2 = 9.92$, $df = 9$, $p = .36$, CFI = .99, RMSEA = .04, AIC = 45.92).

Table 5 shows the results of the simultaneous path analysis of sibling relationships and conduct problems. Model 4 (RMSEA = .00, AIC = 126.59) yielded the best model fit statistics. Model 4 showed that the path coefficients from Posi 1 to Conduct Problems among Twin 1 or YSs (Conduct 1) and those from Posi 2 to Conduct Problems among Twin 2 or OSs (Conduct 2) were equal between MZs and DZs. In addition, the path coefficients from Nega 1 to Conduct 1 and from Nega 2 to Conduct 2 were equal between the three groups. Moreover, *covP* and *covN* were equal between MZs and DZs, and *covE* was equal between MZs and singletons. Figure 3 shows the standardized path coefficients and correlation coefficients of Model 4. Sibling Positivity decreased self-Conduct Problems among all three groups. However, the path coefficients among MZs (−.47 and −.40) and DZs (−.32 and −.44) had greater absolute values than those among singletons (−.11 and −.11). Sibling Negativity increased self-Conduct Problems among all three groups to the same extent. In addition, Sibling Positivity increased the Conduct Problems of the other sibling among MZs and DZs to the same extent. On the other hand, these elements decreased among singletons.

Sibling relationships and peer problems. The best-fit model among MZs was that in which *a1*, *b2*, *covP*, *covN*, and *covE* existed (Figure 4a: $\chi^2 = 15.84$, $df = 10$, $p = .10$, CFI = .95, RMSEA = .10, AIC = 49.84). The best-fit model among DZs was that in which *a1, b1, covP,* and *covN* existed (Figure 4b: $\chi^2 = 9.83$, $df = 11$, $p = .55$, CFI = 1.00, RMSEA = .00, AIC = 41.83). The best-fit model among singletons was that in which paths *a1*, *b1, covP*, *covN*, and *covE* existed (Figure 4c: $\chi^2 = 14.04$, $df = 10$, $p = .17$, CFI = .97, RMSEA = .07, AIC = 48.04).

Table 6 shows the results of the simultaneous path analysis of sibling relationships and peer problems. Model 4 (RMSEA = .03, AIC = 132.23) yielded the best model fit statistics. Model 4 showed that the path coefficients from Posi 1 to Peer Problems among Twin 1 and YS (Peer 1) and Posi 2 to Peer Problems among Twin 2 and OS (Peer 2) were equal between DZs and singletons. Moreover, *covP* and *covN* were equal between MZs and DZs, and *covE* was equal between MZs and singletons. Figure 4 shows the standardized path coefficients and the correlation coefficients of Model 4. Sibling Positivity increased self-Peer Problems among MZs and decreased those among DZs and singletons. Sibling Positivity increased Peer Problems of the other sibling among DZs. On the other hand, Sibling Positivity decreased these among singletons. Sibling Negativity did

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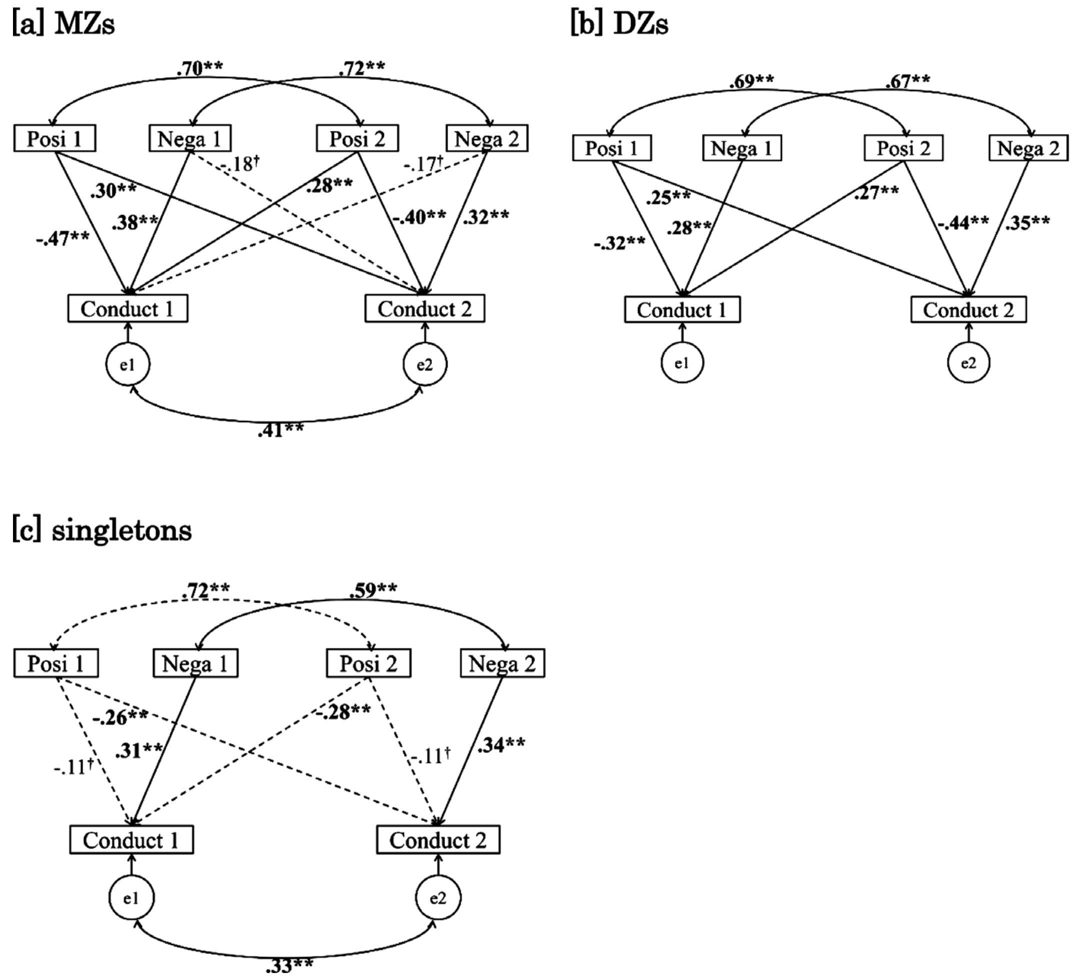

FIGURE 3

The standardized path coefficients and the correlation coefficients of the best fitting model in the relation between sibling relationships and conduct problems.
Note. Conduct 1: Conduct Problems of Twin 1 or YS; Conduct 2: Conduct Problems of Twin 2 or OS.
†: $p < .1$; *: $p < .05$; **: $p < .01$.

not impact Peer Problems, except that Sibling Negativity decreased Peer Problems of the other sibling in MZs.

Discussion

This study showed that sibling relationships affected children's social adjustment, specifically Prosocial Behaviors, Conduct Problems, and Peer Problems among both twin siblings and singleton siblings. Our results confirmed previous studies, which showed the links between sibling relationships and children's social adjustment among singleton siblings (Brody, 1998). However, our results were partially inconsistent with those obtained by Bekkhus et al. (2011), who reported that twin sibling relationships were not associated with Peer Problems. Bekkhus et al. (2011) investigated twins in the year prior to beginning school and the first year of school, asking about sibling relationships between the two siblings as a unit. Our study, on the other hand, investigated twins at 5 years of age, and mothers answered regarding sibling relationships for each child separately. These differences in methods probably underlie the differences observed between our study and that of Bekkhus et al. (2011).

By performing simultaneous path analysis, we found both similarities and differences between twin siblings and singleton siblings: in terms of similarities, positivity toward one's sibling increased self-Prosocial Behaviors and decreased self-Conduct Problems. Further, negativity toward one's sibling decreased self-Prosocial Behaviors and increased self-Conduct Problems.

Differences between twin siblings and singleton siblings included a greater effect of Sibling Positivity on Prosocial Behaviors and Conduct Problems among twins than among singletons. Twin siblings interact with each other more often than do singleton siblings (Thorpe & Danby, 2006). In addition, the interactions between twin siblings seem

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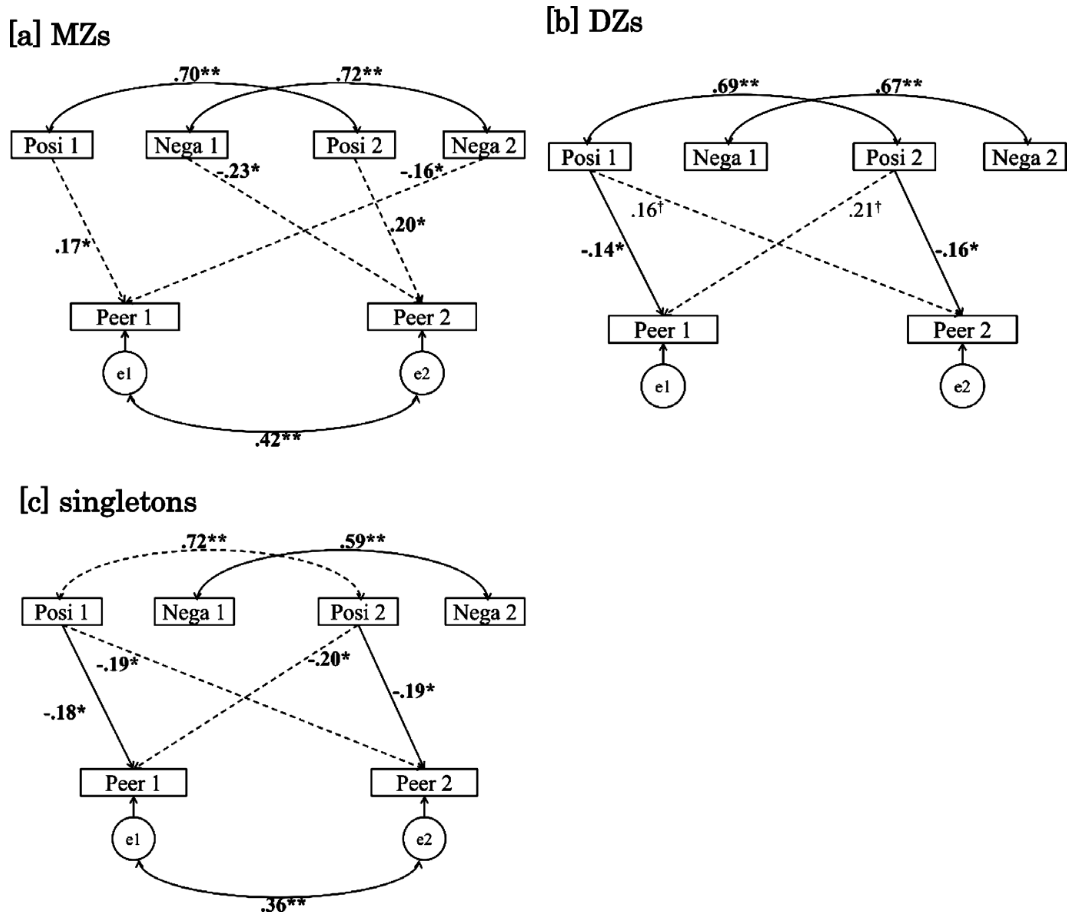

FIGURE 4

The standardized path coefficients and the correlation coefficients of the best fitting model in the relation between sibling relationships and peer problems.
Note. Peer 1: Peer Problems of Twin 1 or YS; Peer 2: Peer Problems of Twin 2 or OS.

TABLE 6

The Fit Indices and AIC of Each Model of Sibling Relationships and Peer Problems

	χ^2	*df*	*p*	CFI	RMSEA	AIC
Model 0	39.73	31	.14	.97	.04	139.73
Model 1	62.32	39	.01	.92	.06	146.32
Model 2	55.47	38	.03	.94	.05	141.47
Model 3	47.38	37	.12	.96	.04	135.38
Model 4	**42.23**	**36**	**.22**	**.98**	**.03**	**132.23**
Model 5	40.59	35	.24	.98	.03	132.59

Note: Model 0: All parameters are different between three groups. Model 1: *a1*, *covP*, and *covN* were equal between three groups. *b1* was equal between DZ and singletons. *covE* was equal between MZ and singletons. Model 2: The same as Model 1 except that there was no equality constraint on *b1*. Model 3: The same as Model 2 except that *a1* was equal between DZ and singletons. Model 4: The same as Model 3 except that *covP* was equal between MZ and DZ. Model 5: The same as Model 4 except that *covN* was equal between MZ and DZ.

to be less complementary and more reciprocal than those between singleton siblings. Most previous studies have regarded complementarity between siblings as important in the promotion of children's social development (Pike et al., 2005; Ruffman et al., 1998; Volling et al., 1997). However, in this study, we instead suggest the importance for children's social development of having many interactions with siblings and establishing reciprocity in sibling relationships.

Interestingly, the effect of Sibling Positivity on Peer Problems among MZs was different from that among DZs and singletons. Positivity toward one's sibling increased Peer Problems only among MZs; this comprised the opposite impact of that found among DZs and singletons. Nevertheless, there were no statistical differences between MZs and DZs in terms of overall Sibling Positivity and Peer Problems. This result is related to the study by Zahn-Waxler et al. (1992), which reported that MZs who were cooperative and prosocial with each other were relatively unlikely to be empathic toward peers. They reported that MZs differed from DZs in that more cooperation with each other was linked to greater empathy for peers among DZs. Upon comparison of the data from singleton and twin siblings in this study, our results suggest that the quality of

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sibling relationships among MZs may be different from those among DZs and singletons. This difference may arise from differences in genetic relatedness among MZs, DZs, and singletons. Many behavioral genetic studies have shown that MZs, who are genetically identical, are more similar than DZs and singletons in various domains, including personality, sociocognitive abilities, and language abilities (Plomin et al., 2008). This could lead to MZs having more similar interests and timing in terms of the starting and stopping of play. Thorpe and Gardner (2006) indicated that MZs share more friends than DZs. Therefore, our results might arise from differences in social relationships between MZs and DZs. We suggest that such differences in genetics and social relationships exist not only between MZs and DZs but also between MZs and singletons.

This study has several limitations. First, all siblings in this study were same-sex pairs. Including opposite-sex siblings is more advantageous for understanding sibling relationships and children's social development than including only same-sex siblings, because opposite-sex siblings may provide different perspectives and possible models, such differences can in turn improve social competence (Cassidy et al., 2005; Laffey-Ardley & Thorpe, 2005). We need to study the effects of sibling relationships among opposite-sex pairs on children's social adjustment in the future. Moreover, this study collected data only through maternal reports. Maternal reports of negative relationships between siblings are not necessarily significantly correlated with sibling conflict assessed by behavioral observation (Cutting & Dunn, 2006). Pike et al. (2005) showed that parent-reported relationships between siblings had a stronger effect on children's social adjustment than those reported by children. It is therefore necessary to achieve more robust results and to generalize our discussion by using multiple methods to estimate sibling relationships. Finally, this study was performed at only one time point with twins who were 5 years old. Therefore, the change in the relation between sibling relationships and children's adjustment through time cannot be determined by this study. It is necessary to perform future follow-up studies to investigate such temporal changes.

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