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Sharing genes fosters identity fusion and altruism

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ABSTRACT

Researchers have shown that the more genes twins share, the more they care about one another. Here, we examine a psychological mediator of such genetic influences, “identity fusion” (a visceral sense of oneness with them). Results supported this hypothesis. Relative to dizygotic twins, monozygotic twins reported stronger fusion and elevated desire to have contact and share experiences with their twin (Study 1), to forgive and grant favors to their twin after being disappointed by him/her (Study 2), and willingness to make sacrifices for their twin (Study 3). Fusion with the twin mediated the impact of zygosity on these outcomes. These findings demonstrate that genetic relatedness fosters a powerful feeling of union with one’s twin that predicts sharing, tolerance, and self-sacrificial behavior toward him or her.

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Identity fusion; zygosity; altruism; forgiveness; twin relationships

Twins who share all of their genes (monozygotic or MZ twins) maintain closer contact and cooperate more than twins who share half of their genes (dizygotic or DZ twins). Nevertheless, little is known about the proximate psychological mechanisms that underlie the special bond between identical twins. In this report we test the idea that identity fusion, a visceral sense of oneness with another entity, may help explain the strong attachment that identical twins have to one another. Specifically, in three studies we test the hypothesis that degree of fusion between twins mediates the impact of zygosity on several manifestations of closeness with the twin, including desire for contact, tolerance, and self-sacrificial behavior. This is the first attempt to examine how identity fusion varies as a function of zygosity and how the feeling of oneness with the twin affects twin relationships.

Identity fusion among twins

The bonds that MZ twins form toward one another are remarkably intense (Neyer, 2002). Relative to DZs, MZs report more: intimate relationships (Segal, 2000); time spent together

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(Rose, 2002); frequent contact and propinquity (Rose, Kaprio, Williams, Viken, & Obremski, 1990); mutual support and cooperation (Neyer, 2002; Segal & Hershberger, 1999), mutual trust (McGuire, Segal, Whitlow, Gill, & Clausen, 2010); and grieving following the loss of the twin (Segal & Ream, 1998). Although the intensity of MZ bonds is beyond question, the psychological mechanism that gives rise to these bonds is not. We propose that the identity fusion formulation (Gómez & Vázquez, 2015; Swann & Buhrmester, 2015) may be useful here.

Researchers developed identity fusion theory to explain the extreme behaviors that people sometimes enact for their group (Swann, Jetten, Gómez, Whitehouse, & Bastian, 2012). They defined identity fusion as a visceral feeling of oneness with a group that occurs when the boundaries between personal identity and the group are permeable. Feelings of fusion are associated with a sense of oneness with the group and the perception that the group and the self reciprocally strengthen one another (Gómez, Brooks et al., 2011). Identity fusion predicts willingness to fight and die for fellow group members (Gómez, Brooks et al., 2011; Swann, Gómez, Seyle, Morales, & Huici, 2009), self-sacrifice to save group members who are imperiled in moral dilemmas (Swann, Buhrmester et al., 2014; Swann, Gómez et al., 2014), and donating blood for fellow group members (Buhrmester, Fraser, Lanman, Whitehouse, & Swann, 2015). In addition, those persons who were more fused with their battalion were also more likely to engage in front line combat in the 2011 Libyan revolution (Whitehouse, McQuinn, Buhrmester, & Swann, 2014) and transsexuals who were more fused with their desired sex were more likely to undergo sex-reassignment surgery (Swann et al., 2015).

Although most past research has focused on large, extended groups, fusion is a particularly powerful moderator of behavior toward small, family-like groups (Whitehouse et al., 2014) and dyads (Vázquez, Gómez, Ordoñana, & Paredes, 2015). Indeed, when asked to specify the group for which they would be most willing to die, people from all over the world overwhelmingly nominated a small group—family (Swann, Buhrmester et al., 2014).

Fusion with small groups may be a particularly strong predictor of pro-group behavior because perception of shared core characteristics (e.g., genes) tends to be high in such groups. For example, encouraging fused persons to focus on shared core characteristics of members of their country (genes or values) increased their endorsement of making extreme sacrifices for their country (Swann, Buhrmester et al., 2014). One marker of shared genes is appearance (DeBruine, 2002). For example, through a process known as “phenotypic matching,” MZ twins may note the nearly identical appearance of their twin and experience a strong perception of physical oneness. This perception of oneness may, in turn, foster feelings of fusion, tolerance, and willingness to make sacrifices for the twin.

Shared life experiences may also promote fusion among MZ twins. That is, based on the appearance of MZ twins, other people may develop similar expectations about them and hence treat them more uniformly than they treat DZ twins (Scarr & Carter-Saltzman, 1979). As a consequence, MZ twins will share more experiences with one another than DZs (Joseph, 2013) and these shared experiences may foster the perception of oneness associated with fusion (Jong, Whitehouse, Kavanagh, & Lane, 2015; Whitehouse & Lanman, 2014).

Identity fusion with the twin is related but different from other measures of interpersonal closeness. For instance, self-expansion theory (Aron & Aron, 1996; Aron, Aron, & Smollan, 1992) states that people use close relationships to self-expand by including others in the

self. The inclusion of others in the self increases one's material resources, social networks, identities and perspectives, much as aggressor companies in hostile takeovers acquire the resources of the company they have acquired. In contrast, identity fusion involves *sharing* rather than *appropriating* qualities of the other person or group. Moreover, identity fusion involves an irrevocable devotion to the group or its members (i.e., Gómez, Morales, Hart, Vázquez, & Swann, 2011) that is absent from the self-expansion model. Alignment with the other not only makes strongly fused individuals feel stronger, it also compels them to strengthen the group through their actions, including extraordinary actions.

Consequences of fusion with one's twin

The relatively high levels of fusion experienced by MZ twins should influence several behaviors. For example, fusion should predispose people to have more contact with the twin (see Neyer, 2002). In addition, strongly fused participants should be more inclined to "coexperience" activities and various social outcomes.

Fusion should also influence how people react to a disappointment caused by the twin. That is, although previous research on identity fusion has not examined reactions to disappointment *per se*, fused individuals did remain loyal to their group even after some of its members have excluded them (Gómez, Morales et al., 2011). Given that exclusion from the group is surely disappointing, this finding suggests that fusion will encourage people to forgive disappointing behavior on the part of the twin.

Moreover, based on evidence that fusion predicts willingness to sacrifice oneself for the group (Swann & Buhrmester, 2015), we expect that individuals who are strongly fused with their twin will be more willing to make sacrifices for the twin. We tested these hypotheses in three studies conducted with pairs of MZ and DZ twins.

One final question is whether the gender of DZ participants (same vs. different) will make a difference. Previous research exploring the personal relationships between DZs of different and same gender shows mixed results. Relative to different-gender DZs, same-gender DZs have been found to share more friends with their twin (Thorpe & Gardner, 2006), but to have a less favorable image of him/her (Danby & Thorpe, 2006) and higher levels of conflict and rivalry (Fortuna, Goldner, & Knafo, 2010). At first sight, one would expect that the higher physical similarity of same-gender DZs would increase fusion and its correlates as compared with DZs differing in gender. However, social expectations and parental treatment (e.g., more comparisons among twins the more alike they are) might promote stronger competitiveness among DZs of same gender as compared to DZs of different gender, which ultimately would reduce fusion. Insofar as these opposing forces neutralize each other, differences due to the gender of DZs may fail to materialize.

Study 1: Zygosity, identity fusion, and desire for contact/coexperience

Study 1 tested whether zygosity would influence fusion with the twin and, in turn, desire for contact and coexperience with him/her. We expected that relative to DZs, MZs would display higher fusion with the twin and desire for contact and coexperience. Moreover, we anticipated that fusion with the twin would mediate the relationship between zygosity and the outcome variables (Appendix 1).

Method

Participants

Trained personnel recruited participants on the telephone from the Murcia Twin Registry (MTR) (Ordoñana et al., 2013). The MTR is a population-based registry of adult multiples in a region of Spain, Murcia. The MTR collects information from the twins periodically to examine the relative contribution of genetic and environmental factors to the development of complex phenotypes, focusing on health and health-related behaviors. Participation in the MTR is voluntary, subjected to informed consent, and not remunerated. Twin zygosity is ascertained by a 12-item questionnaire, which corresponds well with zygosity as determined by DNA testing with an agreement in nearly 96% of the cases (Ordoñana et al., 2013). Besides the measures reported, participants answered additional demographic and health-related questions that are not included here. More detailed information about recruitment procedures and data collection is provided elsewhere (Ordoñana et al., 2013).

Because there was no precedent for examining the impact of zygosity on fusion scores, it was difficult to estimate effects sizes. To err on the side of caution, we recruited a larger sample for Study 2, which includes two predictor variables, and considerably smaller samples for the remaining studies. The samples of the three studies were different. We deleted a total of 130 participants (Study 1: $N = 30$; Study 2: $N = 60$; Study 3: $N = 40$; $M_{\text{age}} = 57.51$, $SD = 7.23$; 51.5% women) because their twin did not participate in the study. Note also that the degrees of freedom associated with the analyses vary slightly because participants occasionally failed to complete all measures.

One hundred and ninety twins (50.5% females, mean age = 55.69, $SD = 6.24$) participated in Study 1. Table 1 shows the sample distributions of all studies according to Gender and Zygosity.

Procedure

Participants learned that they would be participating in a study of health that included several questions unrelated to this study. To avoid participant fatigue, we included short scales in all studies.

Identity fusion with the twin was measured by an adapted version of the fusion scale developed by Gómez, Brooks et al. (2011), consisting of 3 items (e.g., “I am one with my twin”) ranging from 0 (completely disagree) to 10 (completely agree), $\alpha = .70$ (.69 and .76 for Study 2 and 3, respectively).

Desired contact with the twin was assessed by a 3-item scale developed for this study (e.g., “How often do you visit your twin?”) ranging from 0 (never) to 6 (several times per day), $\alpha = .71$.

Desire for coexperience was evaluated by a 3-item scale developed for this study (e.g., “I would prefer for me and my twin to perform the same on tasks and tests”) ranging from 0 (completely disagree) to 10 (completely agree), $\alpha = .70$.

Table 1. Composition of the samples.

	Study 1 ($n = 190$)	Study 2 ($n = 482$)	Study 3 ($n = 226$)
1. MZs males	28	72	54
2. MZs females	28	118	34
3. DZs males	34	92	32
4. DZs females	36	76	48
5. DZs opposite-sex	64	124	58

Results

Analytic strategy

Regression analyses were used based on the sandwich or Huber-White variance estimator (Gould & Scribney, 1999), which adjusts estimated standard errors to account for data dependence between twins in a pair and provides statistical tests that are robust to model assumptions. STATA 12.0 was used to conduct those analyses. All significance tests were two-tailed. We were particularly interested in two comparisons: (a) MZs vs. Dzs, and (b) same-gender DZs vs. different-gender DZs. To make these comparisons, we used an orthogonal coding method, the Helmert Contrast (West, Aiken, & Krull, 1996). For the first comparison we created a new variable named D1 and coded as $-2/3$ (MZs), $1/3$ (same-gender DZs) and $1/3$ (different-gender DZs). For the second comparison we created a new variable named D2 and coded as 0 (MZs), $-1/2$ (same-gender DZs) and $1/2$ (different-gender DZs). Both variables were entered simultaneously in the regression analyses.

Overview

Table 2 shows descriptive statistics and correlations. Since gender (-1 female, 1 male) and D1 are dichotomous, the correlations involving these two variables are point-biserial. D1, D2, and fusion correlated significantly with desire for contact and coexperience. However, fusion was correlated more strongly with the outcome measures than D1 and D2. Desire for contact and coexperience were positively correlated.

Fusion with the twin. Prior to analyzing the effect of fusion on our outcome variables, we regressed the control-age and gender of the participant (-1 female, 1 male)-and zygosity variables (D1 and D2) on fusion with the twin. The effect of D1 (MZs vs. DZs) was significant, $B = -1.00$, Wald $\chi^2(1) = 9.26$, $p = .002$, indicating stronger fusion in MZs than in DZs, $M = 7.97$, $SD = 1.73$ vs. $M = 7.01$, $SD = 2.33$. The effect of D2 (same-gender vs. different gender DZs) was also significant, $B = -1.56$, Wald $\chi^2(1) = 12.80$, $p < .001$, indicating stronger fusion in same-gender DZs than in different-gender DZs, $M = 7.76$, $SD = 1.94$ vs. $M = 6.19$, $SD = 2.45$. The effect of gender was also significant, $B = 0.28$, Wald $\chi^2(1) = 4.16$, $p = .04$, indicating a slight tendency of males to feel stronger fusion than females, $M = 7.02$, $SD = 2.33$ vs. $M = 7.57$, $SD = 2.04$.

Desire for contact with and coexperience with the twin. We conducted two hierarchical regression analyses on desire for contact and coexperience with the twin respectively. In the first step (Model 1) we entered the control-gender and age- and zygosity variables (D1 and D2). In the second step (Model 2) we added fusion with the sibling to the model.

Table 2. Study 1. Descriptive statistics and correlations.

	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7
1. D1			–						
2. D2				–					
3. Gender					–				
4. Age	55.69	6.24	.05	–.05	.01	–			
5. Fusion	7.29	2.21	–.20**	–.29**	.13	.07	–		
6. Desire for contact	3.69	1.44	–.19*	–.27**	.02	–.11	.45**	–	
7. Desire for coexperience	6.96	2.34	–.15*	–.17*	–.01	.03	.60**	.44**	–

* $p < .05$; ** $p < .01$.

In the regression on desire for contact with the twin the value of R^2 of Model 2 significantly increased as compared to Model 1. As shown in Table 3, the effect of D1 was significant in Model 1. MZs reported having more desire for contact with their twin than DZs, $t(180) = 2.59, p = .01, Ms = 4.10$ and $3.51, SDs = 1.42$ and 1.42 , respectively. The effect of D2 was also significant in Model 1, indicating that same-gender DZs expressed a stronger desire to have contact with their twin than different-gender DZs, $t(124) = 3.98, p < .001, Ms = 3.95$, and $3.00, SDs = 1.22$ and 1.46 , respectively. However, when identity fusion was included in Model 2 the effects of D1 and D2 reduced and identity fusion was the strongest predictor of desire for contact with the twin.

In the regression on coexperience the value of R^2 of Model 2 significantly increased as compared to Model 1. As shown in Table 3, the effects of D1 and D2 were only significant in Model 1, indicating that MZs expressed a stronger desire for coexperience than DZs, $t(188) = 2.06, p = .04, Ms = 7.49$ and $6.73, SDs = 1.86$, and 2.48 , respectively, and that same-gender DZs expressed a stronger desire for coexperience than different-gender DZs, $t(132) = 2.26, p = .02, Ms = 7.19$ and $6.23, SDs = 2.18$ and 2.70 . However, in Model 2 the only significant effect was the effect of fusion.

Mediational analyses

To test our hypotheses that fusion with the twin would mediate the effect of zygosity on our outcome variables, we conducted two bootstrapping tests (n boots = 5000) using Model 4 of PROCESS (Hayes, 2013) on desire for contact with the twin and desire for coexperience. The two Helmert contrasts were the predictors. Fusion with the twin was included as a mediator (centered) and age and gender as covariables. The analysis (see Figure 1) on desire for contact showed that the indirect effect via fusion was significant for both contrasts: Indirect effect (IE) for D1 = -0.26 , 95% CI = -0.4566 to -0.1075 , and IE for D2 = -0.38 , 95% CI = -0.6742 to -0.1682 .

The analysis (see Figure 2) on desire for coexperience showed that the indirect effect via fusion was significant for both contrasts: Indirect effect (IE) for D1 = -0.64 , 95% CI = -1.0616 to -0.2832 , and IE for D2 = -1.00 , 95% CI = -1.5994 to -0.5284 .

Discussion

Study 1 showed that relative to DZs, MZs displayed higher levels of fusion, desire for contact and coexperience with the twin. Furthermore, identity fusion fully mediated the effects of zygosity variables on the outcome measures. Unexpectedly, same-gender DZs pairs showed higher levels of fusion, desire for contact and coexperience with the twin than different-gender DZs. We will determine if this finding replicates in Study 2. In addition, Study 2 tested whether the pattern of results obtained in Study 1 would emerge with a different outcome measure, participants' reactions to being disappointed by their twin.

Study 2: Zygosity, fusion, and reactions to disappointment

In Study 2 we examined the link between zygosity, identity fusion and reactions to disappointment. As in Study 1, we expected that MZs would be more fused with their twin than DZs. We predicted also that readiness to forgive the twin would depend on the interaction between zygosity and previous disappointments. Finally, we expected that the effect of zygosity on forgiving would be mediated by feelings of fusion.

Table 3. Study 1. Regression analyses.

Predictors	Desire for contact with the twin						Desire for coexperience					
	Model 1			Model 2			Model 1			Model 2		
	<i>B</i>	<i>SEB</i>	β	<i>B</i>	<i>SEB</i>	β	<i>B</i>	<i>SEB</i>	β	<i>B</i>	<i>SEB</i>	β
D1 (MZs vs. DZs)	-.62**	0.29	-.20	-.36	0.25	-.12	-.079*	0.38	-.15	-.15	0.26	-.03
D2 (DZs)	-.98***	0.30	-.28	-.60*	0.27	-.17	-.95†	0.49	-.17	0.06	0.36	.01
Gender	0.04	0.11	.03	-.04	0.10	-.02	-.03	0.16	-.01	-.01	0.12	-.09
Age	-.03	0.02	-.12	-.03	0.02	-.13	0.01	0.03	.03	0.00	0.02	-.01
Fusion				0.26***	0.05	0.39				0.64***	0.07	.60
<i>R</i> ²	.13			.26			.05			0.36		
<i>F</i> for change in <i>R</i> ²	3.87**			10.28***			1.83			18.19***		

Note: The standardized coefficients were not calculated with robust analyses.
[†]*p* = .06; **p* < .05; ***p* < .01; ****p* < .001.

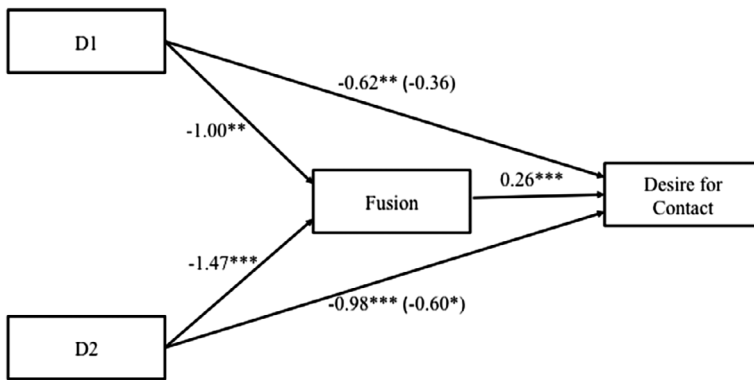


Figure 1. Study 1. Indirect effects via fusion on desire for contact with the twin.

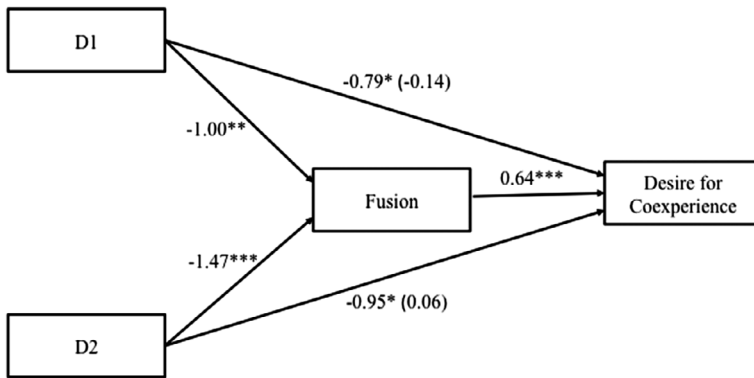


Figure 2. Study 1. Indirect effects via fusion on desire for coexperiencing with the twin.

Method

Participants

Four hundred and eighty-two participants (53.1% females, mean age = 55.78, SD = 6.76) were drawn from the population-based Murcia Twin Registry.

Procedure

The procedure was similar to Study 1, with the major change being the shift to a new outcome measure. To assess *disappointment* with the twin, we asked participants whether they had ever felt disappointed because his/her twin did not defend him/her when someone criticized him/her or was not willing to do him/her a favor. Participants answered Yes or No to this question. Participants then indicated the extent to which they would be willing to (a) give their twin another chance and trust him/her again or (b) grant their twin whatever favor that he/she asked. The scale ranged from 0 (not willing at all) to 10 (completely willing). Since the correlation between these last items was modest, $r(462) = .58$, we conducted separate analyses.

Results

Overview

As in Study 1, we used Helmert contrasts to check whether there were differences between MZs and DZs on the one hand, and among same and different-gender DZs on the other hand. Table 4 shows that D1 (the first contrast comparing MZs to DZs) and fusion correlated significantly with reactions to disappointment. However, D2 (comparing DZs of different and same gender) did not correlate with any of the dependent variables. Fusion was a stronger predictor of reactions than zygosity.

Fusion with the twin. Prior to analyzing the effect of fusion on our outcome variables, we regressed the control–age and gender (–1 female, 1 male)- and zygosity variables (D1 and D2) on fusion with the twin. The only significant effect was the effect of D1, $B = -1.23$, Wald $\chi^2(1) = 29.52$, $p < .001$, indicating stronger fusion in MZs than in DZs, $M = 7.88$, $SD = 1.93$ vs. $M = 6.68$, $SD = 2.10$. No other effects were significant, $ps > .41$.

Willingness to trust the twin again. We conducted a regression on willingness to trust the twin again to determine how zygosity variables, previous disappointment, and fusion affect this variable. As in Study 1, in the first step (Model 1) we entered the control (age and gender) and zygosity variables (D1 and D2). In the second step (Model 2) we added previous disappointment and the interaction between previous disappointment and zygosity variables. In the third step (Model 3) we included fusion with the twin. As Table 5 shows that the value of R^2 of Model 2 significantly increased as compared to Model 1, and the value of R^2 of Model 3 significantly increased compared to Model 2. In model 1 the effects of D1 and gender were significant, indicating that MZs were more willing to trust their twin again than DZs, $Ms = 9.66$ and 9.31 , $SDs = 0.84$ and 1.61 , and that females were more willing to trust their twin again than males, $M = 9.61$, $SD = 1.21$ vs. $M = 9.25$, $SD = 1.50$. In Model 2, a main effect of disappointment emerged indicating that twins that had not been disappointed were more willing to trust their twin than those who did report a disappointment, $Ms = 9.65$ and 8.97 , $SDs = 0.93$ and 2.00 , respectively. This main effect was qualified by the interactive effect between D1 and disappointment, indicating that zygosity affects willingness to trust the twin when there has been a previous disappointment, $B = -0.84$, $t(454) = -3.58$, $p < .001$, but not when no previous disappointment has been reported, $B = -0.14$, $t(454) = -0.94$, $p = .35$. That is, DZs are less inclined to trust their twin if they had been previously disappointed by him/her compared to MZs, $M = 8.63$, $SD = 2.36$ vs. $M = 9.59$, $SD = 1.07$. However, no differences

Table 4. Study 2. Descriptive statistics and correlations.

	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7	8
1. D1			–							
2. D2				–						
3. Gender					–					
4. Age	55.78	6.76	.13**	.15**	–.02	–				
5. Disappointment				–.05	.03	.00	–			
6. Fusion	7.15	2.12	–.28**	.03	–.04	.01	–.21**	–		
7. Another chance	9.45	1.36	–.12**	.06	–.13**	–.03	–.22**	.27**	–	
8. Favor	9.38	1.36	–.11*	.01	–.07	–.00	–.16**	.28**	.58**	–

Notes: 73.5% of participants reported no previous disappointment.

* $p < .05$; ** $p < .01$.

between DZs and MZs emerged when no previous disappointment had been reported, $M = 9.47$, $SD = 1.15$ vs. $M = 9.73$, $SD = 0.66$. In Model 3 the effect of D1 became non significant after including fusion. The effects of previous disappointment remained significant in Model 3, whereas the interactive effect became marginal. The effect of fusion was significant.

Willingness to do a favor. We conducted a similar regression on willingness to do a favor. As Table 6 shows, the value of R^2 of Model 2 significantly increased as compared to Model 1, and the value of R^2 of Model 3 significantly increased compared to Model 2. In model 1 the effect of D1 was significant, indicating that willingness to do the twin a favor was greater among MZs than DZs, $M_s = 9.56$ and 9.26 , $SD_s = 1.06$ and 1.51 .

In Model 2, a main effect of disappointment emerged indicating that twins that had not been disappointed were more willing to do their twin a favor than those who did report a disappointment, $M_s = 9.55$ and 9.02 , $SD_s = 1.10$ and 1.84 . The effect of the interaction between D1 and disappointment did not reach significance. However, zygosity affected the willingness to do the twin a favor when there has been a previous disappointment, $B = -0.60$, $t(469) = -2.43$, $p = .02$, but not when no previous disappointment has been reported, $B = -0.18$, $t(469) = -1.24$, $p = .22$. That is, DZ twins are less inclined to do a favor if he/she had previously disappointed him/her twin as compared to MZ twins, $M = 8.79$, $SD = 2.16$ vs. $M = 9.37$, $SD = 1.15$. However, no differences between DZs and MZs emerged when no previous disappointment had been reported, $M = 9.45$, $SD = 1.15$ vs. $M = 9.63$, $SD = 1.02$.

Table 5. Study 2. Regression analysis on willingness to trust the twin again.

Predictors	Model 1			Model 2			Model 3		
	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β
D1	-0.26*	0.12	-.09	-0.46*	0.18	-.17	-0.28	0.17	-.10
D2	0.14	0.20	.04	-0.06	0.33	-.02	0.00	0.32	.00
Gender	-0.15*	0.06	-.11	-0.15*	0.06	-.11	-0.15**	0.06	-.11
Age	-0.01	0.01	-.03	0.00	0.01	-.02	-0.01	0.01	-.03
Disappointment				-0.38**	0.12	-.25	-0.30**	0.11	-.20
D1*Disappointment				-0.39*	0.19	-.14	-0.35 [†]	0.19	-.13
D2*Disappointment				-0.28	0.35	-.08	-0.22	0.34	-.07
Fusion							0.12***	0.03	0.19
R^2	.03			.09			.13		
<i>F</i> for change in R^2	3.29*			3.70***			4.43***		

Notes: The standardized coefficients were not calculated with robust analyses.

[†] $p = .06$; * $p < .05$; ** $p < .01$; *** $p < .001$.

Table 6. Study 2. Regression analysis on willingness to do the twin a favor.

Predictors	Model 1			Model 2			Model 3		
	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β
D1	-0.27*	0.13	-.10	-0.41*	0.18	-.15	-0.20	0.19	-.07
D2	-0.02	0.18	-.01	-0.28	0.28	-.08	-0.22	0.28	-.06
Gender	-0.07	0.06	-.05	-0.07	0.06	-.05	-0.07	0.06	-.05
Age	0.00	0.01	.01	0.00	0.01	.02	0.00	0.01	.01
Disappointment				-0.29**	0.11	-.19	-0.21 [†]	0.11	-.14
D1*Disappointment				-0.26	0.18	-.09	-0.21	0.18	-.08
D2*Disappointment				-0.43	0.30	-.13	-0.34	0.30	-.10
Fusion							0.15***	0.04	0.24
R^2	.01			.06			.10		
<i>F</i> for change in R^2	2.88*			2.80**			4.13***		

Notes: The standardized coefficients were not calculated with robust analyses.

[†] $p = .05$; * $p < .05$; ** $p < .01$; *** $p < .001$.

In Model 3 the effect of D1 became marginally significant, whereas the effect of fusion was significant.

Mediational analyses

To test our hypotheses that fusion with the twin would mediate the effect of zygosity on our outcome variables, we conducted two bootstrapping tests (n boots = 5000) using Model 4 of PROCESS (Hayes, 2013) on willingness to trust the twin again and willingness to do the twin a favor. As in Study 1, the two Helmert contrasts were included as predictors, although the second contrast yielded no significant effects on the outcome variables. Fusion with the twin was considered as a mediator (centered). Gender, age, previous disappointment, and its interactions with Helmert contrasts were entered as covariables. The analyses (see Figures 3 and 4) showed that the effects of D1 on our outcome variables were mediated by identity fusion, $IE = -0.18$, 95% CI = -0.3072 to -0.0878 , for willingness to trust the twin again, and $IE = -0.21$, 95% CI = -0.3440 to -0.1198 for willingness to do the twin a favor. Regarding D2, neither the total, nor the indirect and direct effects were significant (none of the confidence intervals contained 0).

Discussion

This second study indicated that relative to DZs, MZs displayed higher identity fusion and more willingness to trust the twin again and do him/her a favor interactively with past disappointment. MZ twins were more willing than DZs to trust their twin and help him/her again if they had been previously disappointed by him/her. When no past offenses were reported, MZs and DZs reacted similarly. Among DZs, within-pair gender had no effect on fusion with twin.

As in Study 1 fusion mediated the effect of zygosity on the outcome variables and explained most of the variance. In the last study we explored whether the differences between MZs and DZs also entails a prioritization of the twin over other relatives.

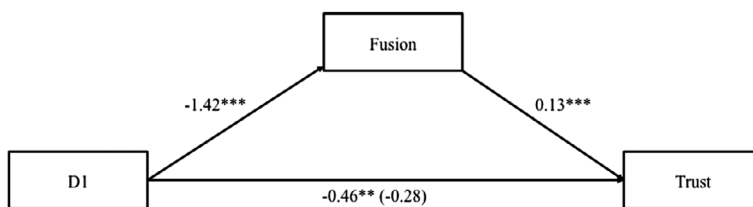


Figure 3. Study 2. Indirect effect via fusion on willingness to trust the twin.

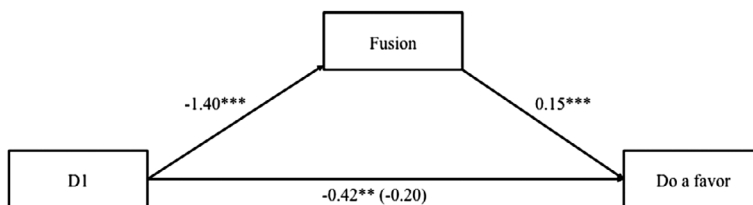


Figure 4. Study 2. Indirect effect via fusion on willingness to do the twin a favor.

Study 3: Zygosity, fusion, and willingness to engage in pro-twin behavior

Study 3 explored the relationship between zygosity, fusion, and willingness to engage in pro-twin behavior. We predicted that MZs would express more willingness to do for their twin more than for their parents and children, and that this effect would be mediated by identity fusion.

Method

Participants

Two hundred and twenty-six participants (49.1% females, mean age = 55.30, SD = 6.37) were drawn from the population-based Murcia Twin Registry.

Procedure

We used the same procedure as in previous studies. To evaluate the *willingness to prioritize the twin over other relatives*, we asked participants who had living parents and children to indicate (a) to what extent they would do for their twin more than they would do for their parents and (b) to what extent they would do for their twin more than they would do for their children. Responses to these two items ranged from 0 (completely disagree) to 10 (completely agree), $r(163) = .56$.

Results

Overview

As in previous studies, we used Helmert contrasts to compare MZs vs. DZs (D1) and same-gender DZs vs. different-gender DZs (D2). Table 7 shows that D1 and fusion correlated significantly with willingness to prioritize the twin over parents and children. However, the correlations of fusion were higher than the correlations of zygosity. Willingness to prioritize the twin over the parents and over one's children were also positively correlated. The correlations of D2 were not significant.

Table 7 shows the descriptive statistics. Lower scores on the prioritization items indicate that participants did not agree to do more for their twin than for other relatives, whereas higher scores indicate that participants would do more for their twin than for other relatives. The mean score of the item regarding the prioritization of the twin over one's children is below the midpoint of the scale, $t(205) = -27.27$, $p < .001$, suggesting low agreement with the idea of giving priority to one's twin over one's children.

Table 7. Study 3. Descriptive statistics and correlations.

	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7
1. D1			–						
2. D2				–					
3. Gender					–				
4. Age	55.30	6.37	.15*	–.04	.05	–			
5. Fusion	6.97	2.36	–.20**	.06	–.02	.03	–		
6. Pro-parents intentions	5.42	2.71	–.18*	.02	–.06	–.02	.56**	–	
7. Pro-children intentions	3.31	2.73	–.16*	.03	–.01	–.05	.39**	.56**	–

* $p < .05$; ** $p < .01$.

We conducted two hierarchical regression analyses on prioritizing the twin over parents and children. In the first step (Model 1) we entered the control (age and gender) and zygosity variables (D1 and D2). In the second step (Model 2) we added fusion with the twin to the model.

Fusion with the twin. Prior to analyzing the effect of fusion on our outcome variables, we regressed the control and zygosity variables on fusion with the twin. The only significant effect was the effect of D1, $B = -1.03$, Wald $\chi^2(1) = 8.74$, $p = .003$, indicating stronger fusion in MZs than in DZs, $M = 7.55$, $SD = 2.14$ vs. $M = 6.60$, $SD = 2.42$. No other effects were significant, $ps > .25$.

Willingness to prioritize the twin over one's parents. In the regression on willingness to prioritize the twin over one's parents the value of R^2 of Model 2 significantly increased as compared to Model 1. As shown in Table 8, the only significant effect was the effect of D1, indicating that relative to DZs, MZs expressed more willingness to do more for their twin than for their parents, $Ms = 6.00$ and 5.01 , $SDs = 2.87$ and 2.53 , respectively. However, in Model 2 there was only a significant effect of fusion.

Willingness to prioritize the twin over one's children. In the regression on willingness to prioritize the twin over one's children the value of R^2 of Model 2 significantly increased as compared to Model 1. As shown in Table 8, Model 1 only yielded a significant effect of D1, indicating that MZs expressed higher willingness to do more for their twin than for their children as compared to DZs, $Ms = 3.86$ and 2.97 , $SDs = 2.93$ and 2.55 , respectively. However, in Model 2 there was only a significant effect of fusion.

Mediational analyses

To test our hypotheses that fusion with the twin would mediate the willingness to do for the twin more than for parents and for one's children we conducted two bootstrapping tests (n boots = 5000) using Model 4 of PROCESS (Hayes, 2013). The two Helmert contrasts were entered as predictors although the second contrast (D2) had no effect on the outcome variables. Fusion was considered as the mediator. Gender and age were included as covariables. The mediational analyses (see Figures 5 and 6) showed that the indirect effects of D1 via identity fusion were significant: -0.56 , 95% CI = -1.0553 to -0.1129 for parents,

Table 8. Study 3. Regression analyses.

Predictors	Prioritizing the twin over one's parents						Prioritizing the twin over one's children					
	Model 1			Model 2			Model 1			Model 2		
	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β
D1	-1.13*	0.46	-.20	-0.57	0.42	-.10	-0.90*	0.44	-.16	-0.47	0.40	-.08
D2	0.04	0.50	.00	-0.02	0.44	.00	0.09	0.44	.01	-0.05	0.43	-.01
Gender	-0.29	0.22	-.11	-0.15	0.18	-.05	-0.09	0.20	-.03	-0.04	0.18	-.01
Age	0.01	0.04	.01	0.00	0.03	.01	-0.01	0.03	-.02	-0.02	0.03	-.05
Fusion				0.60***	0.09	.54				0.43***	0.07	.37
R^2	.04			.32			.03			0.16		
<i>F</i> for change in R^2	1.61			15.00***			1.20			9.29***		

Notes: The standardized coefficients were not calculated with robust analyses.
* $p < .05$; ** $p < .01$; *** $p < .001$.

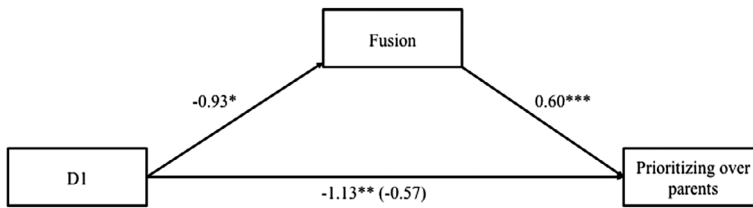


Figure 5. Study 3. Indirect effect via fusion on willingness to prioritize the twin over parents.

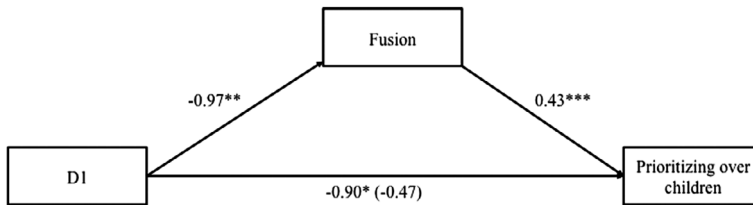


Figure 6. Study 3. Indirect effect via fusion on willingness to prioritize the twin over children.

and -0.42 , 95% CI = -0.7491 to -0.1451 for children. The indirect effects of D2 were not significant (none of the confidence intervals contained zero).

Discussion

Consistent with studies 1–2, fusion and willingness to sacrifice for one's twin was higher in MZs than in DZs. Once again fusion mediated the effects of zygosity and explained most of the variance found in our outcome variables. Similarity of gender among DZs produced no effects.

Meta-analysis on identity fusion

To check whether there were differences in fusion among MZs and DZs of different and same gender, we collapsed data from the three studies. An ANOVA on identity fusion with gender and age as covariables yielded a significant effect of group, $F(1, 893) = 28.92$, $p < .001$, $\eta^2 = .06$. Bonferroni tests indicated that MZs, $M = 7.81$, $SD = 1.96$, felt significantly stronger fusion with their twin than same-gender and different-gender DZs, $M_s = 6.86$ and 6.58 , $SD_s = 2.24$ and 2.23 , $p_s < .001$. However, the difference in fusion between same-gender and different-gender DZs was not significant, $p = .28$.

General discussion

Our research helps explain how evolutionary principles and psychological mechanisms combine to explain prosociality among kin. To that end, we explored for the first time the influence of identity fusion on twin relationships. Consistent with evolutionary theory (Hamilton, 1964), zygosity exerted a strong influence on self-reported behaviors and behavioral intentions towards the twin across three studies. Relative to DZ twins, MZs expressed more desire for contact and coexperience with their twin and a stronger willingness to forgive

him/her after being disappointed, and to do for him/her more than for their parents and children.

More importantly, these findings identify one of the psychological mechanisms by which genetic relatedness affects willingness to act on behalf of one's twin. Fusion with the twin mediated the relationship between zygosity and prosocial behavioral intentions. MZs were more fused with their twin than DZs and their stronger feelings of fusion enhanced their readiness to engage in pro-twin behavior.

In addition to identity fusion, a number of proximal causes of altruistic behavior have been established so far, such as emotional closeness (Curry, Roberts, & Dunbar, 2013; Korchmaros & Kenny, 2001), empathy (De Waal, 2008), normative obligation (Gans & Silverstein, 2006), and similarity (Rushton, 1998). Future studies should determine the relative influence of each mechanism and describe their interactions, if any.

Our findings also contribute to greater understanding of twin relationships and altruism. In Study 3, participants showed biologically significant preferences in that they were not more inclined to help their twin than their children. Given the high mean age of our participants (47–73), saving one's children would be biologically more advantageous than saving older relatives (e.g., parents or twins) whose reproductive period ended (see Wang, 1996). Nevertheless, consistent with evolutionary hypotheses (Hamilton, 1964), the willingness to prioritize the twin over one's children was more pronounced in MZs as compared to DZs indicating that zygosity may significantly affect the hierarchy via identity fusion.

Whereas clear differences emerged between MZs and DZs in fusion and its correlates across three studies conducted with different samples and exploring various outcomes, differences among DZs were smaller and inconsistent. A meta-analysis of the three studies showed no differences in fusion between same-gender and different-gender DZs. Only in Study 1 different-gender DZs felt less fused with their twin than same-gender DZs and, consequently, expressed a weaker desire to have contact and coexperience with him/her. In Studies 2–3, however, fusion with the twin and willingness to forgive the twin and to prioritize him/her over other relatives were similar for both types of DZs. The outcome measures of Study 1 were related to the activities that twins make together, which are likely to be influenced by gender schemas (Bem, 1981). However, gender similarity was not as important when more costly behaviors were examined, for instance, when forgiving the twin or prioritizing him/her over other relatives.

Finally some limitations should be noted. First, some results could be different if we had included younger pairs of twins. For instance, for participants of childbearing age helping a MZ twin –not a DZ– would be more biologically significant than helping one son/daughter (Wang, 1996). Second, to avoid fatigue some constructs were assessed by means only of one item. Third, for ethical reasons, our outcomes measures referred to hypothetical situations and behavioral intentions and we refrained from asking participants to choose between their twin and children (Korchmaros & Kenny, 2001). Fourth, since all measures were assessed simultaneously we cannot establish causality with great confidence. Nevertheless, based on previous research (Gómez & Vázquez, 2015; Swann et al., 2012) the predicted path from fusion to behavioral intentions seems to be more plausible than the alternatives.

Conclusion

In three studies conducted with pairs of MZ and DZ twins we showed that identity fusion consistently mediated the effect of zygosity on the behavioral intentions towards one's twin.

MZs were more fused with their twin than DZs and, in turn, they displayed elevations in desire for contact and coexperience with their twin, endorsements of forgiving the twin after an imagined disappointment and willingness to make sacrifices for the twin compared to other relatives. These results suggest that identity fusion may be a key evolved mechanism of psychological kinship.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Appendix 1.

All scales ranged from 0 to 10 unless otherwise specified. 0 means completely disagree and 10 means completely agree.

IDENTITY FUSION (Common to all studies)

1. I identify with my twin
2. I am one with my twin
3. I'll do for my twin more than any of other family members would do
4. My twin is stronger because of me

Study 1

DESIRED CONTACT WITH THE TWIN

1. When you are not physically in the same place than your twin, how frequently do you think of your twin?
2. How often do you telephone him/her, send him/her mobile messages, whatssapps, emails?
3. How often do you visit your twin?

DESIRE FOR COEXPERIENCE

1. If my twin finds something he/she is interested in then I will want to participate in that as well
2. I would prefer for me and my twin to perform the same on tasks and tests
3. I want people treat me and my twin the same

Study 2

PREVIOUS DISAPPOINTMENT

Have you ever been in a situation with your twin any time in your life in which your twin did something related to you that you did not expect and that was annoying?. For instance, he/she did not defend you when someone criticized you, or you asked him/her for a favor and he/she was not willing to do it.

Yes

No

WILLINGNESS TO GIVE THE TWIN ANOTHER CHANCE

To what extent would you be willing to give your twin another chance and trust him/her again?

WILLINGNESS TO DO A FAVOR

To what extent would you be willing to do your twin whatever favor he/she asked you?

Study 3

WILLINGNESS TO PRIORITIZE THE TWIN OVER OTHER RELATIVES

1. I would do for my twin more than I would do for my parents
2. I would do for my twin more than I would do for my children