The interplay between adolescent friendships and resilience following childhood adversity

Running head: The interplay of adolescent resilient functioning and friendships

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Abstract

Background: Up to 50% of children and adolescents growing up worldwide experience some form of adversity in early life. Childhood adversity (CA) is a major predictor of the development of mental health disorders in adolescence. However, not all adolescents who experience CA go on to develop psychopathology; their mental health functioning can be described as *resilient*. Resilient functioning in adolescents following CA is facilitated by resilience factors, a key one being friendships. During adolescence peer relationships undergo significant change: peer evaluation and peer influence are heightened, social networks gradually become more stable and social reciprocity increases. It is unknown whether resilient functioning after CA fluctuates with these normative changes in the peer related social environment.

Methods: Here, we used Latent Change Score Modelling in a large sample of adolescents from the ROOTS cohort (N=1238, (Lewis, Jones, & Goodyer, 2015)) to examine whether and how emergent friendships and resilient functioning at ages 14 and 17 inter-relate and change together.

Results: We found that friendships and resilient functioning had a strong association at age 14. Higher resilient functioning in 14 year old adolescents with a history of CA was associated with a positive change in friendships from age 14 to age 17. Finally, we found that improvements in friendships and resilient functioning go hand in hand, even when taking into account baseline levels of both, and the change within friendships or resilient functioning over time, as well as the relationship between resilient functioning and change in friendships over time.

Conclusions: We show that friendships and resilient functioning after CA inter-relate and change together between ages 14 and 17. Fostering strategies to improve friendships over the adolescent period is likely to improve resilient functioning within the same timeframe in this vulnerable adolescent group.

Keywords: Childhood Adversity; Resilience; Mental Health; Adolescence; Friendships

Abbreviations:

CA: Childhood Adversity

PCA: principle component analysis.

SES: Socio economic status

MFQ: The Mood and Feelings questionnaire

RCMAS: Revised Children's Manifest Anxiety Scale self-report questionnaire

LOI: Short Leyton Obsessional Inventory

CBCL: Child Behaviours Checklist

RRS: Ruminative Response Questionnaire

CAMEEI: Cambridge early experiences interview

Introduction

Adolescence, defined as the period of life between puberty and adult independence, is a time characterized by marked cognitive, hormonal and neuro-developmental maturation as well as a rapid rise in the incidence of mental health disorders (Blakemore & Mills, 2014; Collishaw, 2015; Crone & Dahl, 2012; Maughan, Collishaw, & Stringaris, 2013; Thapar, Collishaw, Pine, & Thapar, 2012). Approximately 30% of adolescent-onset mental health problems are attributable to childhood adversity (CA)(Green et al., 2010). CA comprises of negative experiences in early life that children that children need to adapt their functioning to, such as trauma, abuse, neglect and/or bullying (McLaughlin, 2016). Up to 50% of children and adolescents growing up worldwide experience such traumatic and stressful events, implicating a vast percentage of the population at risk for subsequent mental illness (WHO, 2014). However, not all individuals who experience CA go on to develop psychopathology. Interestingly, An estimated 10-25% of adolescents with CA do not develop mental health problems (Walsh, Dawson, & Mattingly, 2010). Here, we aim to begin to understand what sets these apparently unaffected individuals apart at a high risk period in adolescence, by examining whether and how adolescent friendships from ages 14 to age 17 improve mental health after CA.

Individuals with good mental health after CA display resilience; *‘the maintenance or quick recovery of mental health following significant adversity’* (Kalisch et al., 2017). As, resilience refers to the *process* of adaptation to stress (Kalisch et al., 2017, 2019), and can be measured in the form of good mental health functioning after the stressor; *resilient* mental health functioning. Given the negative impact of CA on a wide range of mental health disorders (i.e. depression, anxiety, personality disorders, comorbidity) resilient functioning after CA should refer to good mental health functioning across these psychological domains (Masten, 2007, 2015; Masten & Garmezy, 1985). In addition, given that that differential CA experiences are thought to differentially impact mental health outcomes, it is important that such functioning is better than that of others with similar CA experiences (Michael Rutter, 2012, 2013). Therefore, we recently proposed that resilient functioning should be quantified

as good multivariate mental health functioning relative to the degree of CA experiences (van Harmelen et al., 2017).

Resilient functioning after CA relies on protective ‘resilience’ factors (Kalisch et al., 2017; M. Rutter, 1985) which exist across social, cognitive, neuronal, physiological and genetic levels (Amstadter, Myers, & Kendler, 2014; Cicchetti, 2010; Dudley, Li, Kobor, Kippin, & Bredy, 2011; Karatsoreos, Karatsoreos, & McEwen, 2013). For instance, mental health after CA is improved by social support (van Harmelen et al., 2016, 2017), positive memory recall, low brooding, high self-esteem (Askelund, Schweizer, Goodyer, & van Harmelen, 2019; J Fritz, Fried, Goodyer, Wilkinson, & van Harmelen, 2018; Jessica Fritz, de Graaff, Caisley, van Harmelen, & Wilkinson, 2018), enhanced PFC-limbic connectivity, and low morning cortisol (Ioannidis, Askelund, Kievit, & Harmelen, n.d.; Moreno-Lopez et al., n.d.). These factors interact with mental health symptoms (J. Fritz, Fried, Goodyer, Wilkinson, & van Harmelen, 2018) and form a complex system that is thought to improve cognitive control, emotion regulation and stress responsivity in order to facilitate resilient mental health functioning after CA (Ioannidis et al., n.d.). Therefore, resilient functioning may fluctuate depending on changes in resilient factors and/or the presence of additional stressors. Investigating the temporal dynamics of resilience factors and adolescent resilient functioning is thus critical in order to improve our understanding of adolescent mental health resilience after CA.

Friendship support is a particularly important resilience factor in adolescence (Afifi & Macmillan, 2011; Jessica Fritz et al., 2018; van Harmelen et al., 2017), as the teenage years are marked by increased sensitivity to the peer environment (Blakemore, 2008; Blakemore & Mills, 2014; Knoll, Magis-Weinberg, Lucía, Speekenbrink, & Blakemore, 2015). Research into normative development of friendships in adolescence has shown that between ages 13-17, peer relations gradually develop into stronger reciprocated friendships (Burnett Heyes et al., 2015). As resilient functioning after CA relies, in part, on positive friendships in adolescence, it may be that resilient functioning after CA fluctuates

with such changes in friendships over time. However, as of yet, the mutual dynamics of adolescent resilient functioning after CA and adolescent friendships remain unknown. To address this, we use Latent Change Score Modelling (Kievit et al., 2018) in a large population of community ascertained adolescents (the ROOTS cohort (N=1238 (Lewis et al., 2015))) to examine the relations and interrelations of adolescent friendships and resilient functioning after CA within and between ages 14 and 17.

We hypothesised that there would be a normative increase in friendships from age 14 to age 17 in our sample. Furthermore, based on our previous findings, we expected that friendships at age 14 would positively predict resilient functioning after CA at age 14, and that a positive change in friendships would be associated with an increase in resilient functioning after CA from age 14 to age 17. Finally, we also examined whether the relationships between friendships and resilient functioning after CA were similar or distinct for boys and girls.

Method:***Participants***

Participants were drawn from the ROOTS study, a 3-year longitudinal study of adolescent development in 1238 participants from 18 Cambridgeshire secondary schools between November 2005 and January 2010, see (Ian M. Goodyer, Croudace, Dunn, Herbert, & Jones, 2010; Lewis et al., 2015) for more information on ROOTS. The study was approved by the local Cambridge Research Ethics Committee [RNAG/360]. Written informed consent was obtained from both children and their caregivers.

Measures: ROOTS

The following measures were used to calculate degree of resilient functioning in the larger Roots sample (N=1238). See Supporting information for details. Psychopathological symptoms were assessed with sum scores from: The Mood and Feelings questionnaire (MFQ; Angold, Costello, Messer, & Pickles, 1995), Revised Children's Manifest Anxiety Scale self-report questionnaire (RCMAS; Reynolds & Richmond, 1997), Short Leyton Obsessional Inventory (LOI; Bamber, Tamplin, Park, Kyte, & Goodyer, 2002), Child Behaviours Checklist (CBCL(Achenbach, 1991)) and Ruminative Response Questionnaire (RRQ(Raes & Bijttebier, 2003)). CA was assessed in an interview with the caregiver when the participants were 14 years using the Cambridge Early Experiences Interview (CAMEEI) resulting in participants being classified as having experienced either: optimal; aberrant; discordant; or hazardous parenting (Dunn et al., 2011). Self-reported perceived quality of friendships was assessed at ages 14 & 17 with the Cambridge Friendships Questionnaire (I. M. Goodyer, Wright, & Altham, 1989).

Statistical approach

All analyses were conducted in R version 3.5.1 (2018-07-02) -- "Feather Spray", using the Lavaan package (Rosseel, 2012). At age 14 and age 17, we calculated the degree of resilient functioning for each individual in the sample. Specifically, in line with our previous report (van Harmelen et al., 2017) we calculated a multi-modal composite score for psychosocial functioning (PSF) by conducting a principal component analysis (PCA) on standard-normally transformed individual total scores on the MFQ, RCMAS, S-LOI, BEH, and RRQ questionnaires. Next, we computed the same PCA at age 17. To ensure measurement invariance (or rather, component invariance – see for more details Timmerman (2001)) of the scores, we imposed the set of the first component loadings from the PCA at age 14. In this PCA, scores were rescaled to standard normality at age 14, and scaled using the data at age 17. In both PCAs, the resulting first component scores were inverted so that higher scores indicated better psychosocial functioning (PSF). We next computed an overall CA score by summing scores on early (0-6), late (6-11) and adolescent (11-14) CA experiences. To do so, we recoded the CA classes (Optimal =1, Aberrant =2, Discordant=3, and Hazardous=4), and computed an overall CA score over the three time-periods (early childhood +late childhood +adolescent). Finally, we regressed PSF first component scores on this composite CA score at age 14 and 17 to test for possible linear, quadratic or cubic relationships. From these relations, we extracted the residual scores for the best fitting model as these residual scores reflect *the extent to which an individual has better, or worse, psychosocial functioning than others with similar CA experiences* (van Harmelen et al., 2017); Figure 2a and b). As such, these residual scores reflect individual degree of resilient functioning, with higher scores reflecting more resilient functioning.

Next, we rescaled both resilient functioning and friendships at time 2 in line with Ferrer & McArdle, 2004 to ensure scores are adjusted for differences in the time between time 1 and time 2 for all individuals (Median days=1102). We then established the relationships between resilient functioning and adolescent friendships. First, we examined cross-sectional relations between resilient functioning and adolescent friendships. Second, we examined the change over time from age 14 to 17 within each domain (resilient functioning, or friendships). To do so, we ran a series of

Latent Change Score Models (Kievit et al., 2018). The first, univariate model examined the change in resilient functioning measured at ages 14 and 17. As such models (using observed scores) are saturated, we report and focus our discussion on the key relationships within the model, rather than model fit which will be always be perfect given 0 degrees of freedom. Next, we used a multigroup approach to examine whether the relationships in the model were different for boys and girls. To do so, we compared a multi-group model where all parameters were estimated freely within each group, to a model where key parameters were constrained to be equal, and compared model fit between the two multi-group models using likelihood ratio tests. We implemented the same series of models steps to examine the change in friendships from ages 14 and 17, and any associate gender effects. Third, to examine how friendships and resilient functioning changed together between ages 14 and 17, we fitted a bivariate latent change score model. This model allowed us to examine the reciprocal influences and correlations between friendships and resilient functioning at ages 14 and 17. Such a model allowed us to fit *coupling* parameters: regression parameters which quantify the extent to which the rate of change in one domain (e.g. friendships) is a function of the 'starting point' in the other domain (e.g. resilient functioning), and vice versa. Finally, we examined whether these dynamics were similar or distinct in boys vs girls by fitting and comparing multi-group models with and without equality constrains.

Results

Sample descriptives

At age 14, N=1141 had full data on all measures needed for the analysis. When compared to those who did not have full data (N=97), this sample was slightly younger (Mean age= 14.51 vs 14.58 ($t(69.96) = 2.07, p = .04$). The two groups varied slightly on socio economic status (SES; $X^2(4) = 11.20, P = .02$) and gender distribution ($X^2(1) = 3.90, P = .05$), see Table 1 for details). At age 17, we had full data on all measures used for N=887 individuals. When compared to those who did not have data at age 17 (N=351), this sample had similar age at time 1 ($t(518.61) = .72, p = .46$), and gender distribution ($X^2(1) = 2.15, p = .14$), but had a different SES distribution ($X^2(4) = 15.16, p < .004$), see table S1 for details.

Quantifying individual degree of psychosocial functioning at age 14 and age 17

The PCA for psychosocial functioning resulted in a first component that explained 66% of the variance across all measures. After inversion for ease of interpretation, higher scores on this first component reflected better psychosocial functioning. The first component factor loadings were; $0.502 * MFQ + 0.51 * RCMAS + 0.44 * LOI + 0.30 * BEH + 0.44 * RRQ$. These component scores were extracted to reflect individual current psychosocial functioning at Age 14. PSF at age 14 and 17 were strongly, positively related ($r = .47, t(849) = 15.36, p < 2.2e-16, 95\% CI; .41-.52$).

Table 1. Sample characteristic

		Time1					Time2				
Samples		Included	Excluded				Included	Excluded			
Total (N=1238)		N=1141	N=97	t/X2	P	BF	N=887	N=351	t/X2	P	BF
Age at Time1		14.51	14.58	2.07	<.05	0.9	14.51	14.52	0.72	0.47	10.4
Gender	males	510	54	3.91	0.05	4	392	172	2.15	0.14	3.94
	females	631	43				495	179			
SES	wealthy/achievers	629	33	11.2	<.05	0.9	506	156	15.16	<.001	7.2
	urban/prosperity	78	2				60	20			
	comfortably off	276	15				209	82			
	moderate means	53	2				41	14			
	hard pressed	105	14				71	48			
	NA		31					31			

SES=Socioeconomic Status

Quantifying individual degree of resilient functioning

At age 14, a linear model regressing psychosocial functioning on CA provided good fit (adjusted $R^2=.03$, $F(1,1088)=39.48$ $p<4.78e-10$, $Est=-0.13$, $SE=0.02$, $t=-6.28$, $p<4.78e-10$, $AIC=4334.359$). A quadratic term did not improve this fit ($Est=-.0049$, $SE=.008$, $t=-0.59$, $p=.55$, $AIC=4336.002$), whereas a cubic model provided the best fit ($R^2=.037$, $F(3,1086)=15.24$, $P<1.018e-9$, $Est=-.008$, $SE=.003$, $t=-2.395$, $p<.017$, $AIC=4332.262$). A likelihood ratio test suggested that a cubic model slightly improved model fit of the linear model ($SSQ=18.88$, $F=3.05$, $p=.05$). At age 17; a linear model provided good fit (adjusted $R^2=.02$, $F(1,854)=22.78$, $p<2.13e-06$, $Est=10.11$, $SE=.02$, $t=-4.77$, $p<2.13e-06$, $AIC=3246.774$), a quadratic term did not contribute above and beyond the linear component ($Est=.009$, $SE=.009$, $t=1.02$, $p=.31$, $AIC=3247.731$), and neither did a cubic term ($Est=-.006$, $SE=.003$, $t=-1.67$, $p=.09$, $AIC=3246.920$). Given the marginal and unstable benefits of adding non-linear components, we rely on the linear model for further analyses at both ages (Figure 1). There was a strong relationship between resilient functioning at age 14 and age 17 ($r=.47$, $t(822)=15.46$, $p<2.2e-16$ 95% CI: .42-.52).

Figure 1 Relationship between Childhood Adversity and resilient functioning at age 14 (A) and 17 (B).

Univariate relationships between resilient function and friendships

There was a strong positive association between friendships at age 14 and resilient functioning at both age 14 and age 17 (Figure 2, Table S1; Age 14; $r=.43$, $t(1063)=15.45$, $p<2.2e-16$, 95%CI=.38-.48; age 17; $r=.23$, $t(826)$, $p<1.312e-11$, 95%CI:.17-.29). Table S1 shows that Gender (Boys had higher

resilient functioning than girls) had a significant association with resilient functioning at ages 14 and 17, but age and SES were unrelated.

Figure 2. Relationships between resilient functioning and friendships at age 14 (A) and 17 (B).

Change in resilient functioning from age 14 to age 17.

There was no overall change (i.e. mean change) in resilient functioning from age 14 to age 17 (-0.043, SE = 0.059, $z = -0.738$, Table 3). However, there were significant individual differences in resilient functioning at baseline, as indicated by significant intercept variance term (estimate=3.15, SE = 0.166, $z = 18.757$). Additionally, there was a significant slope variance term (i.e. rate of change: 2.931, SE = 0.1853, $z = 15.815$) between ages 14 and 17, suggesting individual differences in rates of change over time. We also found a negative self-feedback effect between resilient functioning at baseline and change over time (-1.68, SE = 0.150, $z = -11.144$), suggesting that those high in resilient functioning show a decline in their functioning over time, whereas those low in resilient functioning increased in their functioning over time- Such a pattern of regression to the mean is often observed. Multi-group models testing for gender effects revealed that the relationships were generally similar for boys and girls, with one exception: mean resilient functioning at age 14 was considerably lower for girls (-0.352, se=0.075) than for boys (0.429, se=0.070). Constraining the mean resilient functioning at age 14 to be equal across the groups led to considerable drop in model fit ($\Delta\chi^2(1) =$

54.442, $p < 0.0001$), supporting our findings that girls showed lower mean resilient functioning at age 14.

Table 2. Parameter estimates latent change model for resilient functioning

Parameter	Est	SE	Z	P	CI Lower	CI Upper	Lavaan notation
Change Intercept	-0.04	0.06	-0.74	0.46	-0.16	0.07	dresT1~1
Mean Resilience at T1	0.00	0.05	0.00	1.00	-0.10	0.10	resT1~1
Change Variance	2.93	0.19	15.82	0.0001	2.57	3.29	dresT1~~dresT1
Resilience T1 Variance	3.11	0.17	18.76	0.0001	2.78	3.43	resT1~~resT1
T1-change Covariance	-1.68	0.15	-11.14	0.0001	-1.98	-1.38	dresT1~~resT1

How do friendships change from age 14 to age 17?

When investigating change within friendships from age 14 to 17, the model revealed that there was a mean increase in friendships from age 14 to age 17. As before, there were pronounced individual differences in both baseline friendships (17.668, SE = 0.984, $z = 17.955$; Table 3) and the change in friendships (18.633, SE = 1.084, $z = 17.196$). There was a negative covariance between friendships and rate of friendship increase (-12.008, SE = 0.845, $z = -14.208$), suggesting that those with higher friendships at age 14 tended to show less friendship improvement whilst those with low friendships showed an increase in friendships over time.

Table 3. Parameter estimates latent change model for friendship change.

Parameter	Est	SE	Z	P	CI Lower	CI Upper	Lavaan notation
change Intercept	1.25	0.14	9.18	0.0001	0.98	1.51	dfriendst1~1
Mean Friendships at T1	23.54	0.12	####	0.0001	23.29	23.78	friendst1~1
change Variance	18.63	1.08	17.20	0.0001	16.51	20.76	dfriendst1~~dfriendst1
Friendships T1 Variance	17.67	0.98	17.96	0.0001	15.74	19.60	friendst1~~friendst1
T1-change Covariance	-12.01	0.85	-14.21	0.0001	-13.66	-10.35	dfriendst1~~friendst1

The interplay between friendships and resilient functioning between ages 14 and 17

Next, we examined the interplay between both domains in a bivariate latent change score model. First, we observed a strong positive correlation at baseline (Figure 3; $r=0.43$, $Z=10.342$) between resilient functioning and friendships at age 14, indicating that those with more resilient functioning had higher self-reported quality of friendships. Next, we found that higher quality friendships at age 14 was *not* associated with greater increases in resilient functioning between age 14 and 17 (0.17, SE = 0.15, $z = 1.2$). In contrast, we did observe a robust relationship in the other direction: Those with higher resilient functioning at age 14 showed *greater gains* in friendships between age 14 and age 17 (i.e. 0.265, SE = 0.068, $z = 3.9$, standardized path estimate=0.108). In other words, those with high resilient functioning at age 14 show larger gains in friendships between ages 14 and 17, independent of their friendship levels at age 14. Finally, and intriguingly, even after taking into account this coupling as well as the self-feedback pathways, the changes in resilient functioning and friendships were strongly positively correlated ($r=0.358$, covariance estimate=1.635, SE= 0.233, $Z=7.006$). In other words, changes in friendships and resilience over a three year period go hand in hand, even when taking into account other dynamic effects.

Table 4. Parameter estimates bivariate latent change model for resilient functioning and friendships.

Parameter	Est	SE	Z	P	CI Lower	CI Upper	Lavaan notation
Change Intercept	1.25	0.14	9.18	0.0001	0.98	1.51	dfriendst1~1
Mean Friendships at T1	23.54	0.12	####	0.0001	23.29	23.78	friendst1~1
Change Variance	18.63	1.08	17.20	0.0001	16.51	20.76	dfriendst1~~dfriendst1
Friendships T1 Variance	17.67	0.98	17.96	0.0001	15.74	19.60	friendst1~~friendst1
T1-change Covariance	-12.01	0.85	-14.21	0.0001	-13.66	-10.35	dfriendst1~~friendst1
Change Intercept	-0.04	0.06	-0.74	0.46	-0.16	0.07	dresT1~1
Mean Resilience at T1	0.00	0.05	0.00	1.00	-0.10	0.10	resT1~1
Change Variance	2.93	0.19	15.82	0.0001	2.57	3.29	dresT1~~dresT1
Resilience T1 Variance	3.11	0.17	18.76	0.0001	2.78	3.43	resT1~~resT1
T1-change Covariance	-1.68	0.15	-11.14	0.0001	-1.98	-1.38	dresT1~~resT1
Coupling: Resilience to Friendships	0.26	0.07					dfriendst1~resT1
Coupling: Friendships to Resilience	0.02	0.01					dresT1~friendst1
Covariance at Age 14	3.23	0.31					resT1~~friendst1
Correlated Change	1.64	0.23					dresT1~~dfriendst1

Figure 3. Bivariate latent change score model. Only key parameters are shown as fully standardized estimates – For all parameters see Table 2. Resilient function 14 (17): Resilient functioning assessed at age 14 (17). Change Resilient: latent variable modelled as the change in resilient functioning between age 14 and age 17. Friends 14 (17) self-reported friendship quality assessed at age 14 (17). Change Friendships: the latent variable representing the change in friendships modelled on friendship quality at age 14 and 17. Blue lines indicate cross-domain undirected relationships, green lines indicate directed cross-domain regressions, red lines indicate directed within domain relationships, black lines indicate relationships where parameter estimates were fixed. Circles indicate latent variables and squares indicate observed variables. A: Correlation between change in friendships and change in resilient functioning; B: Correlation between Resilient functioning at age 14 and the change in friendships from age 14-17. ***= $P < .001$.

Discussion

We aimed to examine the relationship between mental health resilient functioning and friendships and their mutual change from age 14 to 17 years. We replicated our earlier cross-sectional findings that friendships are positively related with resilient functioning after CA ($r=.43$ in $N=2890$ ages 14-24, van Harmelen et al., 2017), in this independent cohort of young people (i.e. $r=.43$ at age 14 in $N=1141$). However, in contrast to our earlier findings, and contrary to our hypothesis, greater friendships at age 14 did not lead to greater *gains* in resilient functioning from age 14 to age 17. Rather, we found that higher resilient functioning at age 14 is associated with greater improvements in *friendships* from age 14 to age 17. However, we also found that the change in friendships was strongly related to the change in resilient functioning after CA. This was found after taking into account self-feedback regression pathways (i.e. friendships at age 14 on age 17, resilient functioning at age 14 to age 17) and coupling pathways (i.e. friendships and resilient functioning at age 14, and age 17). Furthermore, we found that, although girls had lower resilient functioning, all dynamics reported above were the same in boys and girls. In sum, we found that improvements in friendships and resilient functioning go hand in hand, even when taking into account baseline levels of both, and the change *within* friendships or resilient functioning over time, as well as the relationship between resilient functioning and change in friendships over time. These findings suggest that the development of adolescent friendships, and resilient functioning after CA is inextricably intertwined.

We found that overall resilient functioning (i.e. mean levels) did not change from age 14 to age 17 in our sample. However, this does not imply that no change was happening: We observed pronounced individual differences in level of resilient functioning at age 14, as well as individual differences in the change over time between ages 14 and 17. Those with higher resilient functioning at age 14 tended to show a decrease in their functioning, whereas those with low resilient functioning at 14 tended to show an increase over the following three years. These findings are suggestive of a 'regression to the mean'. Specifically, if scores are randomly and independently distributed with a

mean of X, then another assessment of these scores at time 2 will result in a decrease or increase towards X, leading to the absence of changes on the group level. Indeed, we did not find average resilient functioning changes on a group level. However, although resilient functioning at age 14 and age 17 were strongly related ($r=0.47$), they were not perfectly related. Indeed, we found that friendships and resilient functioning were strongly related, both at age 14 and in their change from age 14 to 17. Together, these findings do not align with the notion that resilience is a static trait that remains stable over time. Rather, our findings are in line with the suggestion that resilient functioning is dynamic and fluctuates over time (Cicchetti, Rogosch, Lynch, & Holt, 2009; Kalisch et al., 2017; Michael Rutter, 2012), and suggest that resilient functioning after CA depends (in part) on adolescent friendships influences.

There was an overall increase in self-reported quality of friendships from age 14 to age 17 in our sample, which is in line with the notion that friendships become stronger over the adolescent time (Burnett-Hayes, 2015). However, our model suggested that there were significant individual differences in the level of friendships at age 14 and in the change of friendships from age 14 to age 17. Indeed, figure 3 A shows significant variance of individual friendship change scores, with some individuals showing improvements and others decreases from age 14 to age 17. These findings highlight the fact that it is critical to examine individual differences in adolescence (Foulkes & Blakemore, 2018), as our individual differences in friendship change indicate that increases found on a group level do not generalize to the individual level in our sample. Rather, our findings are suggestive of important individual differences that influence the level of friendships experienced in adolescence. Indeed, we found that adolescents with more resilient functioning had higher friendships, and *vice versa*, at age 14. In addition, we found positive coupling between resilient functioning at age 14 and change in friendships between age 14 and 17, suggesting that adolescents with high resilient functioning at age 14 showed an *improvement* in friendships between age 14 and 17, regardless of their initial friendship levels. These findings resonate with those showing that

higher self-esteem is associated with more integrated social networks in 12 year old girls (Pachucki, Ozer, Barrat, & Cattuto, 2015), and that depressive symptomatology negatively impact peer interactions in children (Rockhill et al., 2007). Together with our finding that a change in friendships from age 14 to age 17 was positively associated with a change in resilient functioning in this period, *and vice versa*, our findings corroborate earlier work showing that adolescent mental health resilient functioning and friendships are strongly related. In addition, our findings extend the literature by showing that a change in resilient functioning after CA (or friendships) from age 14 to age 17 may result in a similar change in friendships (or resilient functioning after CA) over this time period.

Friendships did not predict a change in resilient functioning from age 14 to age 17. This seems to contradict findings that adolescent friendships improve later resilient functioning after CA (van Harmelen et al., 2017), and improve mental health in general population samples (Colarossi & Eccles, 2003; Narr, Allen, Tan, & Loeb, 2019; Skrzypiec, Slee, Askell-Williams, & Lawson, 2012). However, on average, the participants in these samples were older (i.e. >15 years), suggesting that friendships may be more beneficial to mental health in later adolescence. Indeed, in late childhood, social influence did not impact mental health in a sample of 12-year-olds (Pachucki et al., 2015). The idea that friendships are more predictive of mental health in later adolescence is in line with the idea that friendships increasingly become more stable and reciprocal between ages 13-17 (Burnett Heyes et al., 2015). Alternatively, as this is the first study that utilized latent change score modelling to investigate the specific relations and interrelations of friendships and resilient functioning change over the teenage years, the results in previous studies could reflect the strong coupling between friendships and resilient functioning that we observed at baseline and in their change.

We show a strong relationship between baseline and change of mental health resilient functioning after CA and peer relationships in young people aged 14 to 17. This relationship may rely on the neurocognitive mechanisms that facilitate positive peer interactions. We recently showed that,

whereas CA has been associated with increased behavioural and neural sensitivity to peer exclusion (van Harmelen et al., 2014), resilient adolescents with CA do not have altered mood or neural responses in response to negative peer feedback from peers (Jessica Fritz et al., 2019). These findings suggest that resilient adolescents with CA may have improved skills and resources to cope with negative interactions with their peers. Indeed, a recent review of the literature suggests that resilient adults with a history of CA show increased resting state functional connectivity in a brain network associated with cognitive control (i.e. the Central Executive Network (Moreno-Lopez et al., n.d.). Cognitive control is a key tenet of executive functioning and refers to the ability to regulate thoughts and actions with goal relevant material (Braver, 2012). As such, cognitive control of emotions is pivotal in successful emotion regulation (Ochsner & Gross, 2005). Indeed, poor cognitive control of emotions was related to difficulties with emotion regulation and mental health problems in young adolescents (11-14) without adversity (Schweizer, Parker, Leung, Griffin, & Blakemore, 2019). Such problems with emotion regulation negatively affect social interactions; depressed children were found to evoke negative peer interactions through displaying more negative emotions (Rockhill et al., 2007). In contrast, resilient adolescents showed enhanced emotion regulation capacity underpinned by reduced recruitment of mPFC and downregulation of amygdala activity in response to negative stimuli in resilient adolescents (Schweizer et al., 2015). Perhaps increased cognitive control and improved emotion regulation helps resilient adolescents to regulate their responses to negative feedback, evoking more positive peer interactions and subsequently positive friendships in adolescence. Examining the specific mechanisms of the relationship between resilient functioning after CA and the social environment should be the subject of future studies.

Limitations

The current findings should be interpreted with the following limitations in mind. First, CA was retrospectively assessed through an interview with the primary caregiver at age 14, potentially resulting in an underreporting of CA (Dunn et al., 2011; Goodyer et al., 2010), which would lower the

predictive validity of CA in our study. However, at the time of interview, the assessor used time intervals (early, middle, and late childhood), which enhanced recall and report accuracy of CA (Dunn et al., 2011). However, caregiver vs self-report, as well as prospective and retrospective reports on CA relate differently to mental illness as well as to different populations of individuals with CA (Newbury et al., 2018; Baldwin et al., 2019). In addition, our sample SES was above UK average (Goodyer et al., 2010), and reported only mild to moderate CA experiences (Walsh et al., 2014). Therefore, future studies should investigate whether our findings generalize to other CA assessments as well as populations with lower SES, severe CA and prospective CA experiences.

Conclusions

We examined how friendships and resilient functioning after CA inter-relate and change together from age 14-17. We found a strong link between these domains at age 14, and we found that increased resilient functioning at age 14 improves friendships change from age 14 to age 17. In addition, we found that the change in friendships from age 14-17 was positively related with the change in resilient functioning over this time. In sum, our finding suggest that adolescent resilient functioning after CA and friendships between ages 14-17 interrelate and change together. These findings have implications for preventative and intervention strategies as they suggest that improvements in friendships between ages 14-17 might lead to improvements in resilient functioning, and vice versa.

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Declaration of interest

The authors have no declaration of any actual or potential conflict of interest including any financial, personal or other relationships with other people or organizations within three years of beginning the submitted work that could inappropriately influence, or be perceived to influence, this work.

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