Adolescent friendships predict later resilient functioning across psychosocial domains in a healthy community cohort

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Wordcount=4188

Abstract=249

This work was supported by a strategic award from the Wellcome Trust to the University of Cambridge and University College London (095844/Z/11/Z), a Netherlands Organization for Scientific Research Rubicon fellowship (AlvH, NO 446-13-006), and a Royal Society Dorothy Hodgkin Fellowship (AlvH, No DH150176).

Abstract

Background: Adolescence is a key time period for the emergence of psychosocial and mental health difficulties. To promote adolescent adaptive ('resilient') psychosocial functioning, appropriate conceptualization and quantification of such functioning and its predictors is a crucial first step. Here, we quantify resilient functioning as the degree to which an individual functions better or worse than expected given their self-reported childhood family experiences, and relate this to adolescent family and friendship support.

Method: We used Principal Component and regression analyses to investigate the relationship between childhood family experiences and psychosocial functioning (PSF: psychiatric symptomatology, personality traits and mental wellbeing) in healthy adolescents (the Neuroscience in Psychiatry Network; N=2389; ages 14-24). Residuals from the relation between childhood family experiences and PSF reflect resilient functioning; the degree to which an individual is functioning better, or worse, than expected given their childhood family experiences. Next, we relate family and friendship support with resilient functioning both cross-sectionally and one year later.

Results: Friendship and family support were positive predictors of immediate resilient psychosocial functioning, with friendship support being the strongest predictor. However, whereas friendship support was a significant positive predictor of *later* resilient functioning, *family* support had a *negative* relationship with later resilient psychosocial functioning.

Conclusions: We show that friendship support, but not family support, is an important positive predictor of both immediate and later resilient psychosocial functioning in adolescence and early adulthood. Interventions that promote the skills needed to acquire and sustain adolescent friendships may be crucial in increasing adolescent resilient psychosocial functioning.

Introduction

Adolescence is a key developmental time period for the emergence of psychosocial difficulties, and mental health disorders (Thapar et al. 2012; Blakemore & Mills 2014). To promote adaptive psychosocial functioning during adolescence, appropriate conceptualisation and quantification of resilient functioning and its predictors is a crucial first step. In psychiatry, resilience refers to "*a dynamic process wherein individuals display positive adaptation despite experiences of significant adversity or trauma*"(Luthar & Cicchetti 2000). In the general population, it is well established that negative childhood experiences such as parental discord and/or lack of parental affection can have a negative impact on adolescent psychosocial functioning (Egeland 2009; Trocmé et al. 2011; van Harmelen 2013; Harpur et al. 2015; Stoltenborgh et al. 2015). Adolescent resilient psychosocial functioning may therefore be seen as reflecting positive adaptation compared to others with similar experiences in the family environment. However, individuals with comparable experiences may not *appraise* their experiences in the same way (Rutter 1985, 2012). For instance, *perceived* levels of threat, rather than actual threat, determine later stress reactivity (van Wingen *et al.* 2011). Therefore, including self-reported appraisal of childhood family experiences may contribute to a more valid and quantifiable measure of adolescent resilient functioning.

Resilience captures positive adaptation across emotional, cognitive, behavioural and social domains of functioning(Masten 2015), and should be relevant to the environmental events and difficulties experienced (Luthar *et al.* 2000). From this multidimensional perspective the presence of personal impairment or psychopathology does not necessarily preclude concurrent resilient functioning (Luthar *et al.* 2000). For example, an adolescent can suffer considerable distress after a personal loss, but simultaneously continue to attend school and learn and see friends and can therefore be considered to be functioning 'resiliently' in those domains despite experiencing berievement. This multidimensional perspective indicates that a valid measure of adolescent resilient functioning in the general population should capture adaptive behaviour across a comprehensive range and level of psychosocial domains. Furthermore, resilient functioning is not a personality trait that is constant over time (Luthar & Cicchetti 2000; Rutter 2012; Cicchetti 2013; Masten 2015). Rather, resilient functioning waxes and wanes, possibly under the influence of protective factors such as family and friendship support (Rutter 1985; Afifi & Macmillan 2011; Cicchetti 2013; van Harmelen *et al.* 2016). Therefore, having low resilience at some time does not preclude the presence of future resilience, or vice versa. Consequently, it is important to study adolescent resilient functioning, and its influences, over time (Bonanno *et al.* 2015). Understanding how adolescent resilient functioning varies over time and revealing how various factors influence such variation remains to be fully elucidated.

Adolescent friendships and family support are important protective factors after early life stress (Rutter 1985, 2012, van Harmelen et al. 2016). Recently, we showed that adolescent family support reduces later depressive symptoms after differential levels of childhood family adversity, whereas adolescent friendship support reduced later depressive symptoms after childhood family adversity and/or peer victimization (van Harmelen *et al.* 2016). These findings support the stress-support matching hypothesis; support should match the type of adversity experienced in order to be most beneficial (Cohen & Wills 1985). This is also evidence for multidimensionality of resilient functioning and further evidences the value of developing a resilient index across domains of experiences. Such a measure has however yet to be reported. Thus, the concurrent and predictive role of adolescent friendships and family supports on adolescent psychosocial resilient functioning across multiple domains (whilst taking self-reported childhood family experiences into account) is unknown.

Here, we investigate the relationship between adolescent family and friendship support on concurrent and prospective adolescent resilient psychosocial functioning in a community sample (N=2389) of healthy adolescents and young adults (ages 14-24) from the longitudinal Neuroscience in Psychiatry Network (NSPN; www.NSPN.org). We quantify a measure of resilient functioning by taking into account both functioning across multiple psychosocial domains (i.e. psychiatric symptoms, personality traits and mental wellbeing) and self-reported experiences of the family environment in childhood in a healthy population. This allows us to create a multidimensional index of functioning from which we can ascertain the degree to which an individual functions better or worse than expected given their family environment in early life. Finally, we test whether such functioning is associated specifically with family and friendship factors concurrently and prospectively one year later using path models.

Methods

Sample

Participants in this report were part of the NSPN study cohort. NSPN is a multi-centre accelerated longitudinal community cohort study focussing on normative adolescent to young adult ('adolescent') development between the ages of 14 and 24. The NSPN cohort (N=2389) completed a home questionnaire pack (HPQ) at baseline (Time 1), and ~one year later (Median=1 year, Mean=1.11 (SE=.01) year, min-max: 0.91-2.69 year), N=1674 individuals from the NSPN cohort completed the same HPQ at Time 2.

For our cross sectional analyses we had complete data on all measures used (Table 1) for N=1890. This cross sectional sample did not differ from the entire NSPN cohort (N=2389) on age (t(4055)=.02, p= 0.98), gender (X^2= 0.01, df = 1, p= 0.91), socio economic status (SES; index of multiple deprivation based on participant postcodes; t (4058)=1.416, p=.16), nor ethnicity (X^2= 4.19, df = 5, p= 0.52). Overall, Table S1 shows that this sample (N=1890) can be described as a healthy sample reporting low levels of psychopathological symptoms, behaviours and personality traits, and average mental wellbeing scores.

For our longitudinal analyses we had complete data for N=1093. This longitudinal sample was not different from the sample used in our cross sectional analyses (N=1890), nor the entire NSPN cohort (N=2389) in terms of age (t (2058 & 2218)< -0.74, p>0.46), and ethnicity distribution (i.e. N=1890: (X^2= 2.73, df = 5, p= 0.74), N=2389(X2= 9.15, df = 5, p= 0.10)). However, there were slightly more females in the longitudinal sample (N=1093; 57% females) when compared to the cross sectional sample (N=1890) and the NSPN cohort (N=2389) (X^2 >4.16, df=1, P<.04), that both had 53% females. Finally, the longitudinal sample (N=1093) had similar SES compared to the cross sectional sample (N=1890) t (2364)=-1.5, p=.13). However, the longitudinal sample (N=1093) had lower SES compared to the NSPN cohort (N=2389) (Mean's 15.5 & 16.9, t(2237)=-2.82, p=.005).

Measures

Psychosocial Functioning (PSF)

Negative family environments in early life form a risk factor for maladaptive- psychiatric symptomatology(van Harmelen *et al.* 2010), -personality traits (Hart *et al.* 1997; Rogosch & Cicchetti 2004), and reduced overall mental wellbeing (Hart *et al.* 1997). Therefore, we focussed our measure of resilient functioning relative to these psychosocial domains to assess overall '*psychosocial functioning*' (PSF)[1]. To do so, we included sum scores of all questionnaires (assessed both at time 1 and 2) that focussed on:

> Psychopathological symptoms: The mood and feelings questionnaire(Angold *et al.* 1995), Revised Children's Manifest Anxiety Scale RCMAS self-report questionnaire(Reynolds & Richmond 1997), Short Leyton Obsessional Inventory(Bamber *et al.* 2002), Kessler Psychological Distress scale (K10(Kessler *et al.* 2002), behaviours checklist.
>
> Personality characteristics: The Antisocial Process Screening Device(Frick *et al.* 2000), The Child and Adolescent Dispositions Scale(Lahey *et al.* 2008), the inventory of Callous-unemo-

[1] As our aim is to capture resilient functioning in its broadest sense, we choose to incorporate the more stable personality traits in our measure of PSF. Note that our results remain the same when we repeated all analyses whilst only including psychiatric symptoms and mental well-being in our PSF variable.

tional traits (ICU) to measure callous and unemotional traits(Roose *et al.* 2010), the Schizotypal Personality Questionnaire (SPQ)(Raine 1991), and the Barratt Impulsivity Scale (BIS)(Stanford *et al.* 2009).

Mental wellbeing: the Warwick-Edinburgh Mental Well Being Scale (WEMWBS)(Tennant *et al.* 2007).

More information about these measures is provided in the supplement.

Childhood family experiences

Appraisal of early life parenting behaviours were measured at baseline and time 2 with two self-report measures; the Alabama Parenting Questionnaire (APQ) and the measure of parenting styles (MOPS).

Measure of Parenting Style (MOPS).

The MOPS is a 12 item self-report measure that assesses perceived parenting styles across three domains; indifference, over-control and abuse(Parker *et al.* 1997). Participants were asked to rate both their mother's and father's parenting behaviour on 15 statements, on a 4 point scale. The full response range is "not true at all", "slightly true", "moderately true", "extremely true". The 'abuse' scale consisted of 5 items, asking whether maternal/paternal behaviours were verbally abusive, unpredictable, physically violent, elicited feelings of danger, or elicited feelings of lack of safety. The 'overly controlling' scale consisted of 4 items where maternal/paternal behaviour was overprotective, over controlling, critical, or made the participant feel guilty. Finally, the 'indifference' scale assessed 6 items of maternal/paternal behaviour where the parent was 'ignoring, uncaring, rejecting, uninterested in, would forget about, or would leave the participant on his/her own a lot. Sum scores to responses in these items were calculated with higher scores representing more abusive, over controlling or indifferent behaviour reported. Internal consistency was good for the maternal subscales (Cronbach's alpha maternal over control=.70, indifference=.86, abuse=.78). For paternal parenting, the internal consistency at baseline ranged from acceptable (Cronbach's alpha paternal over control =.65) to excellent (Cronbach's alphas paternal abuse=.88, paternal indifference =.93).

APQ (Alabama Parenting Questionnaire)

The Alabama Parenting Questionnaire (APQ) measures parenting practices. We used the 9 item short-form (Elgar *et al.* 2006), and added the 'Corporal Punishment' (3 items) and 'Involvement' scale (3 items). Participants were asked to rate how typical each item occurred or used to occur in their family home on a five point scale ranging from "*never", "almost never", "sometimes", "often" to "always*". We calculated sum scores for the five subscales: Positive Parenting, Inconsistent Discipline, Poor Supervision, Involvement, and Corporal Punishment, with higher scores reflecting higher frequency of the behaviour. Thus, high scores can indicate positive parenting (i.e. Involvement, positive parenting), or negative parenting (i.e. Inconsistent discipline, poor supervision, corporal punishment). Internal consistency at baseline was acceptable (Inconsistent discipline & poor supervision: Cronbach's alpha's>.62), and good (Positive parenting, Involvement, Corporal Punishment Cronbach's Alpha's>.71). Note that all results remained when the positive parenting scores (APQ positive parenting and APQ involvement) were removed from the analyses.

Predictors of resilient functioning

FAD (Family Assessment Device)

Adolescent family support was assessed at baseline and time 2 with the McMaster Family Assessment Device (FAD)-General Functioning Scale (FAD-GF(Epstein *et al.* 1983)), administered to adolescents. The FAD-GF is a 12 item self-report questionnaire where respondents rate statements such as "we can express our feelings to each other" or "there are lots of bad feelings in the family". Responses ranged from "Strongly Agree" to "Strongly Disagree". The FAD-GF yields an estimate of overall family functioning(Miller *et al.* 1985). In our analyses, high scores reflect a positive family environment ('family support'). Internal consistency at baseline was very high (Cronbach's alpha = .92).

CFQ (Cambridge Friendship Questionnaire)

Perceived quality of friendships at baseline and time 2 were assessed with the self-report Cambridge Friendships Questionnaire (CFQ) (Memarzia *et al.* n.d.; van Harmelen *et al.* 2016). The CFQ is an 8 item questionnaire assessing the number, availability, and quality of friendships (e.g. 'Do you feel that your friends understand you?', 'Are you happy with the number of friends that you've got at the moment', 'Can you confide in your friends?'). Higher scores indicate better perceived overall quality of friendships (i.e. 'Friendships'). The CFQ has good measurement invariance and external validity, and adequate test retest reliability across two week intervals (Kappa = .80)(Memarzia *et al.* n.d.). Within NSPN, baseline internal consistency was good (Cronbach's Alpha=.72).

Stats and Results

All analyses were conducted in R version 3.03 (Warm Puppy), using the packages Dplyr (Wickham & Romain 2016), Psych(Revelle 2014), Lavaan (Rosseel 2012), and ggplot2(Wickham 2009). All data and code for the below analyses are available from [www.annelauravanharmelen.com/data & https://figshare.com/authors/_/1376682].

To calculate a multi-modal composite score for psychosocial functioning (PSF) we conducted a principal component analysis (PCA) for PSF on standard-normally transformed individual total scores on the MFQ, RCMAS, S-LOI, K10, BCL, APSD, CADS, ICU, SPQ, BIS-11, WEMBES. Similarly, we conducted a PCA including standard-normally transformed sum scores for the MOPS the APQ subscales to create a composite score for childhood family experiences. From both analyses, we extracted individual scores for the first component to reflect individual current PSF and recalled childhood family experience scores. Next, we regressed the PSF component score against the childhood family experiences score, testing for possible linear, quadratic or cubic relationships. From the best fitting regression we extracted the residual scores as these reflect a spectrum ranging from *risk to resilient* functioning: *the extent to which an individual has better, or worse, PSF outcomes than the average score expected given their childhood family experiences* (see for a similar approach Bowes et al. 2010; Miller-Lewis et al. 2013; Sapouna & Wolke 2013; Collishaw et al. 2016). For parsimony, we will refer to these scores as '*resilient functioning*' with higher scores reflecting better (conditional) PSF outcomes.

Next, we predicted resilient functioning from adolescent family and friendship support. Age, gender (coded 0-1, 1 being males), and Socio-Economic status (SES) were specified as covariates. Note that all results remained the same when these covariates were not included in the regressions. We examined these relations cross-sectionally at baseline in N=1890 using multiple regression.

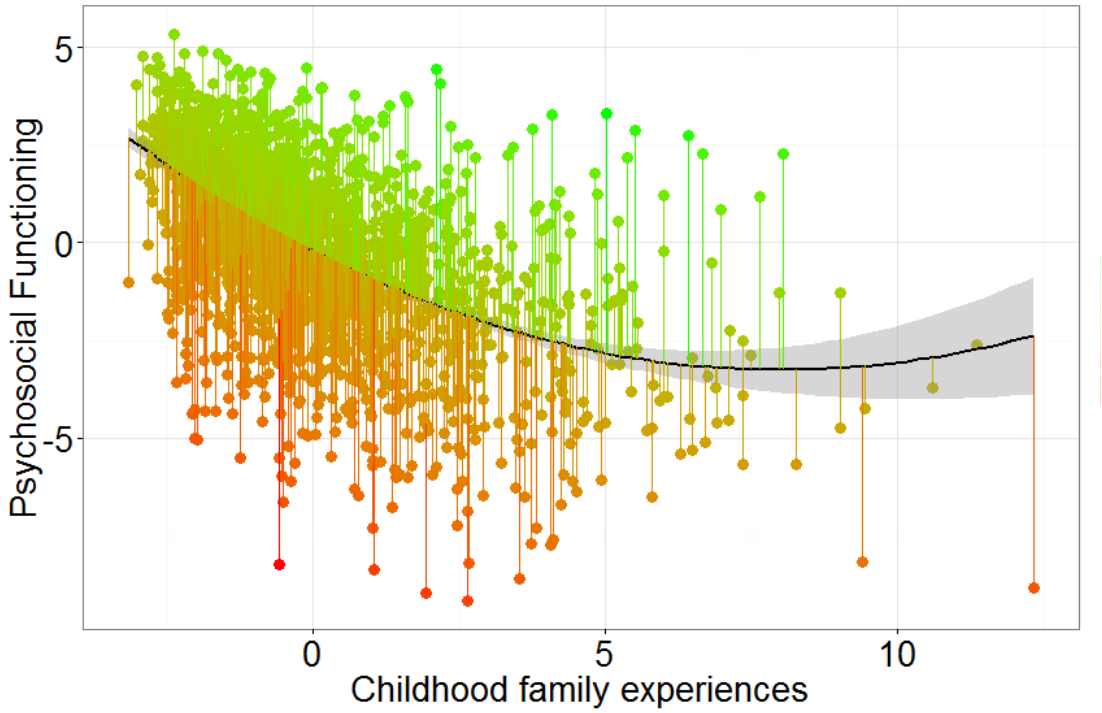
Finally, we investigated whether the relationships between friendship and family support and our multidimensional measure of resilient functioning is dependent on the cross sectional (i.e. simultaneous) timing of assessments, (potentially reflecting reporting bias), or whether these relationships also appeared over time. Therefore, we conducted longitudinal analyses using Structural Equation Modelling (SEM) in Lavaan (Rosseel 2012). We specified a full identified model that tested the relations and interrelations of baseline and later friendships, family support, and resilient functioning. In this model, gender, age and SES were specified as covariates on friendships, family support and resilient functioning at baseline and follow-up.

Results

Resilient functioning; functioning that is better than expected given one's childhood family experiences.

A PCA for PSF (MFQ, RCMAS, S-LOI, K10, BCL, APSD, CADS, ICU, SPQ, BIS-11, and WEMBES) revealed a first component that explained 44% variance. Higher scores on the PSF factor suggest better psychosocial functioning (see Table S2). The PCA for child family experiences revealed a first component that explained 37% variance in the MOPS and APQ subscales (Table S2 for loadings). The childhood family experiences principle component scores were inverted so that a higher score reflects more negative family experiences. We next regressed the childhood family experiences component score on the component score for PSF. This relationship could best be described as quadratic (Figure 1) (Est=-0.76, SE=0.03, t= -24.87, P<2e-16, quadratric term: Est=0.05, SE=0.006, t=7.32, P=3.66e-13, additional information in supplement). Next, individual residual scores were extracted from this relationship as these residuals reflect degree of risk to resilient functioning: *the extent to which an individual functioned better than expected ('high, or resilient'; green lines Figure 1), or worse than expected ('low or risk' red lines Figure 1), given their childhood family experiences.* Note that higher residual scores reflect *more* resilient functioning.

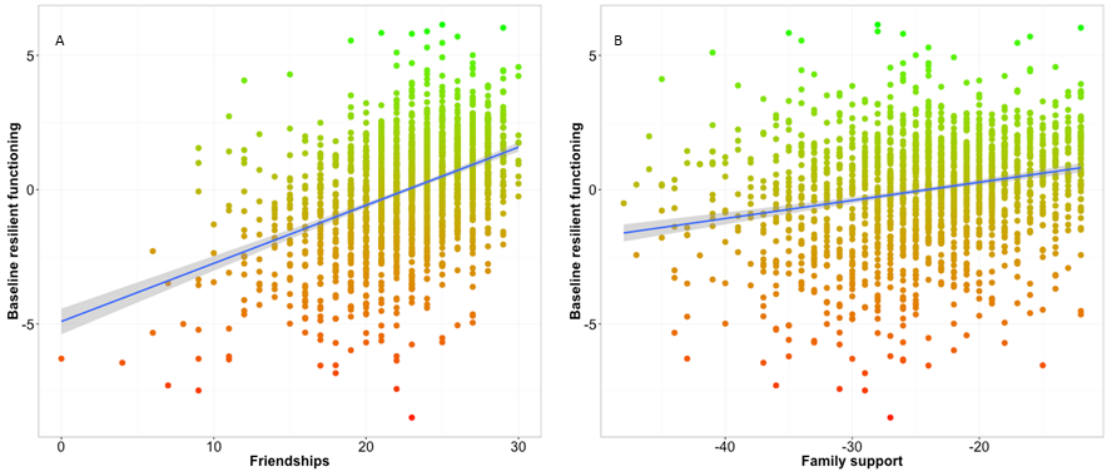
Figure 1. Relationship between Psychosocial functioning and Childhood family experiences in N=1890



Association between adolescent friendships and family support and resilient functioning

Adolescent friendships had a strong positive association with concurrent resilient functioning; more friendship support related to more resilient functioning (*r*=.43, t(1834)=20.57, p<2.2e-16, Figure 2a). Similarly, family support was positively associated with concurrent resilient functioning (*r*=.23, t(1853)=10.37, p<2.2e-16, Figure 2b).

Figure 2. The relationship between friendships (A) and family support (B) and baseline resilient functioning (N=1890)



Friendships and family support were correlated (r=.39, t (1834)=18.67, p< 2.2e-16). Therefore, we next investigated their unique relations with resilient functioning using multiple regression. We defined friendships, family support, gender, age, and SES as predictors of resilient functioning. This analysis showed that friendships and family support were both positive predictors of resilient scores, with friendships being the strongest predictor (Table 1). Furthermore, age and male gender, but not SES, were also associated with resilient functioning.

Table 1. Predictors of resilient functioning at baseline (time 1).

Baseline		Est	beta	SE	t	Pr(>|t|)	
Entire sample (N=1890)	Friendship	0.21	0.41	0.01	17.90	< 2e-16	***
	Family	0.02	0.06	0.01	2.81	0.00	**
	Age	0.05	0.07	0.01	3.22	0.00	**
	Gender	0.31	0.08	0.08	3.67	0.00	***
	SES	0.00	-0.01	0.00	-0.40	0.69	

Longitudinal predictors of resilient psychosocial functioning.

To investigate the relationship between friendships and family support at baseline (time 1) with resilient functioning at time 2 (~one year later) we recalculated resilient functioning scores in a subset of the sample that had complete data on all measures at both times (N=1093; see supplement and Table S4 for details). Resilient functioning at time 1 and 2 had a strong positive association (r=.66, t=28.93, df = 1091, p< 2.2e-16), suggesting that resilient functioning is relatively stable over the course of one year in our sample.

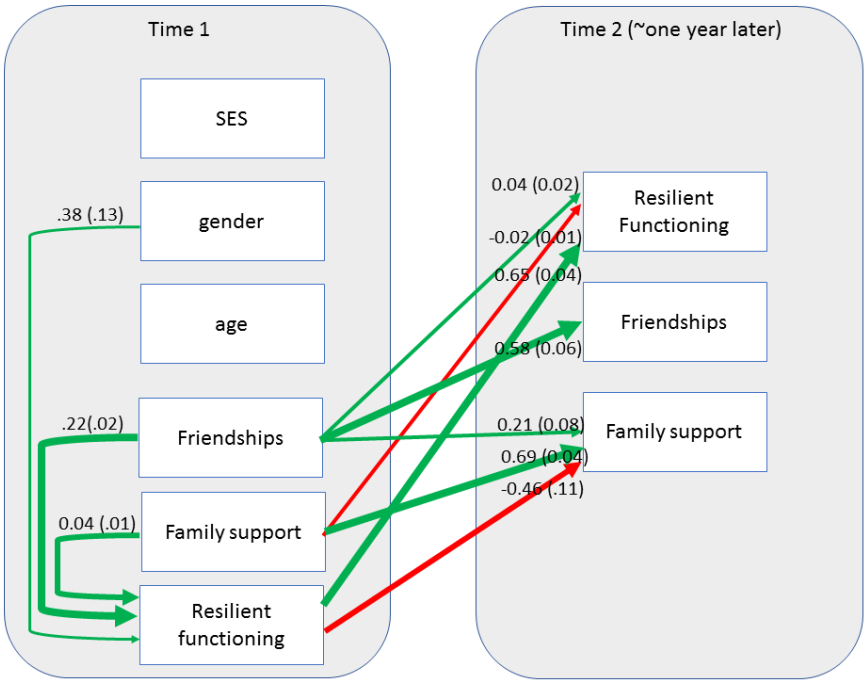
A path analysis showed that adolescent friendships and resilient functioning were significant *positive* predictors of psychosocial resilient functioning over the course of one year (Table 2 and figure 3). In contrast, adolescent family support was *negatively* associated with later psychosocial resilient functioning. Friendships at time 2 were only positively predicted by baseline resilient functioning. Whereas family support at time 2 was positively predicted by baseline family *and* friendship support. Interestingly, family support at time 2 was negatively predicted by baseline resilient functioning. Note that as this path model is saturated, model fit is not informative, but included in the caption of Table 2 for completeness.

Table 2. Predictors of later resilient functioning (N=1093).

Dependent variable	predictors	Estimate	Std.Err	z-value	P(>|z|)
Resilient functioning Time 1	Friendships time 1	0.219	0.023	9.467	0.000
	Family time 1	0.036	0.01	3.494	0.000
	Age time 1	0.03	0.021	1.459	0.144
	Sex	0.378	0.127	2.98	0.003
	SES	0.001	0.005	0.143	0.887
Resilient functioning time 2	Resilient functioning time 1	0.653	0.035	18.563	0.000
	Friendships time 1	0.041	0.017	2.435	0.015
	Family time 1	-0.02	0.008	-2.422	0.015
	Age time 1	0.019	0.016	1.232	0.218
	Sex	0.041	0.1	0.409	0.682
	SES	0.005	0.004	1.286	0.199
Family time 2	Resilient functioning time 1	-0.459	0.114	-4.033	0.000
	Friendships time 1	0.205	0.081	2.541	0.011
	Family time 1	0.69	0.042	16.516	0.000
	Age time 1	0.019	0.072	0.269	0.788
	Sex	-0.039	0.451	-0.085	0.932
	SES	-0.016	0.018	-0.865	0.387
Friendships time 2	Resilient functioning time 1	0.136	0.077	1.763	0.078
	Friendships time 1	0.581	0.059	9.788	0.000
	Family time 1	0.006	0.021	0.274	0.784
	Age time 1	-0.046	0.042	-1.095	0.274
	Sex	-0.14	0.25	-0.56	0.576
	SES	-0.007	0.009	-0.84	0.401
modelfit	X2(0)=0,p=NA, CFI=1, TLI=1, RMSEA=0(0-0)				

Note. Significant positive (green) and negative (red) paths are highlighted.

Figure 3. Significant paths in the Structural Equation Model.



For reasons of parsimony we only depict significant positive (green) or negative (red) paths (unstandardized Estimates and Standard Errors). Thicker lines indicate stronger associations.

Discussion.

Here we examine predictors of adolescent resilient functioning across a range of psychosocial domains ('PSF'; i.e. psychiatric symptoms, personality traits and mental wellbeing) whilst taking into account individual childhood family experiences. We create a measure of resilient psychosocial functioning in three steps: First, we use a data-reduction technique (i.e. PCA) to establish individual composite scores for PSF, and childhood family experiences. Second, we regressed PSF on childhood family experiences. Third, we extract residual scores from this relationship as these reflect individual level of psychosocial resilient functioning: *the degree to which a participant is functioning better or worse than expected based on his/her childhood family experiences,* see for a similar approach (Bowes *et al.* 2010; Miller-Lewis *et al.* 2013; Sapouna & Wolke 2013; Collishaw *et al.* 2016). We found that childhood family experiences have a significant association with PSF in our community sample of healthy adolescents (N=1890). Specifically, recalling more negative family experiences was associated with worsening current PSF, supporting previous studies (Gilbert *et al.* 2009; van Harmelen *et al.* 2010). We then related adolescent friendship and family support with continuous risk to resilient PSF measure. We found that adolescent friendship support, but not adolescent family support, was positively related with immediate *and* later resilient psychosocial functioning.

Friendship and family support were both positive predictors of *immediate* resilient psychosocial functioning. Notably, friendship support was a stronger predictor of immediate resilient functioning than family support, which is in line with the notion that adolescents are especially sensitive to their peer environment (Crone & Dahl 2012). Furthermore, we found that adolescent friendship support was also a positive predictor of *later* resilient psychosocial functioning, which was apparent even after accounting for the effect of baseline resilient functioning and family support. These findings suggest that friendship support may be an important protective factor in adolescence. Our findings corroborate and extend those that showed that adolescent friendship support promotes subsequent resilient functioning in those exposed to negative childhood family environments (Collishaw *et al.* 2007; Powers *et al.* 2009; van Harmelen *et al.* 2016).

The exact mechanisms through which adolescent friendships increases resilient functioning are yet unknown. One potential explanation may be that our friendships score captures individual skills that promote social competence, such as social interaction and relationship building. And social competence could mediate the link between resilient functioning and friendship interactions. However, in our model, the relationship between baseline resilient functioning and later friendships was weak at best. This suggests that our interpretation that friendship promote resilient functioning over time is unlikely to be explained by the alternative notion that prior resilient functioning promotes better social competence (and friendships) and thereby later resilience function. Future studies should however test the specific role of social competence in the link between resilient functioning and subsequent friendships. Other explanations for the link between friendships and resilient functioning may come from studies that suggest that adolescent friendship support may increase resilient functioning through offering companionship(Cohen & Wills 1985) when these interactions are pro-social, as adolescent prosocial peer relationships, but not anti-social relationships, reduced later behavioural problems(Fergusson & Lynskey 1996; Fergusson *et al.* 1996). Friendships may also increase resilient functioning is through increasing interpersonal skills(Buhrmester 1990), and through supporting social decision making skills(Jehn & Shah 1997). Additionally, adolescent friendships may reduce feelings of loneliness(Parker & Asher 1993), and dampen stress responses (Cohen & Wills 1985; Masten *et al.* 2012). Furthermore, friendship support may increase resilient functioning through reducing negative experiences with peers (Pellegrini & Bartini 2000).

Overall therefore these emotion-cognition mechanisms accruing via positive adolescent friendships may increase resilient functioning through updating negative self-cognitions. Negative self-cognitions are found in children that have low peer support; those that have experienced peer victimization (Sinclair *et al.* 2012), or report to be lonely (Vanhalst *et al.* 2015). Negative self-cognitions colour individuals' appraisal and behaviour in interpersonal situations and negatively influence individuals' memories of these situations (Beck 2008). Negative self-cognitions mediate the link between very negative family environments and poor mental health (van Harmelen *et al.* 2010). Adolescent friendship support may offer a unique opportunity to learn from positive peer experiences which perhaps results in a more positive update of self-cognitions. Examining the potential mechanisms through which adolescent friendship support increases psychosocial resilient functioning is an important avenue for future research.

The relationship between adolescent *family* support and resilient functioning across psychosocial domains appeared to be more complicated in our sample. Although family support had a *positive* relationship with immediate resilient psychosocial functioning, family support was *negatively* related with *later* adolescent resilient functioning (when baseline resilient functioning and friendship support were taken into account). These findings are in line with findings that family support is not linked to positive adaptation in more severely maltreated children than those studied here (Cicchetti 2013). It may be that, in adolescence, family involvement is not adaptive, especially in the context of a negative family environment. In line with this idea, adolescent family support was not associated resilient functioning when peer relationships were taken into account (Fergusson & Lynskey 1996). Similarly, family support was not associated with teacher-reported mental health resilient functioning in young children with parental report of high cumulative family adversity (Miller-Lewis *et al.* 2013). Although, family support was positively related with mental health resilient functioning if functioning was reported by parents in these children (Miller-Lewis *et al.* 2013). Finally, our findings are in line with those that friendships, but not family support, are related with self-reported resilient functioning rates on a resilient functioning questionnaire in young adults with histories of child abuse (Howell & Miller-Graff 2014). However, our findings are in contrast with those that suggest that family support is predictive of childhood and early adolescent (ages 13-14) resilient functioning against depressive symptoms after child adversity (Bowes *et al.* 2010, Sapouna & Wolke 2013). These findings also contrast our previous report in a different sample that adolescent family support at age 14 reduces adolescent depressive symptoms at age 17 after CFA (van Harmelen *et al.*2016). Taken together, whereas previous studies suggest that early adolescent family support may predict resilient functioning against later depression, our current findings suggest that adolescent family support is not related with later adolescent resilient functioning when resilient functioning is assessed across multiple psychosocial domains.

Contrary to common concepts of resilient functioning where only the outcomes (e.g. absence of psychopathology, above average functioning) are taken into account (e.g. see for an overview (Klika & Herrenkohl 2013)), we use an approach that allows individuals who have moderate outcomes in the face of very negative childhood family experiences to be included as 'resilient' (Bowes *et al.* 2013; Miller-Lewis *et al.* 2013; Sapouna & Wolke 2013; Collishaw *et al.* 2016). This approach paints a more complete picture of adolescent psychosocial functioning. A limitation of this approach is that taking the subjectivity of self-reported childhood family experiences into account when quantifying resilient functioning may be inherently biased: those that are highly resilient may report more positive childhood family experiences, whereas those that are less resilient may report more negative childhood family experiences. However, current psychopathology has not been found to bias self-report of child abuse and neglect (Spinhoven *et al.* 2010). In fact, previous work suggests that negative childhood experiences are more likely to be *underreported* rather than over-reported (Brewin 2007).

Finally, even if those with low psychosocial resilient functioning over-reported negative family experiences, and those with high psychosocial resilient functioning over reported positive family experiences this would only lead to a *reduction* in power to find associations with resilient functioning. For these reasons, it is unlikely that this limitation would explain our current findings. Finally, an important limitation is that, on average, our sample reported only low levels of negative family experiences at best, and the childhood family experiences score explained only moderate variance r=.37% in the MOPS and APQ assessments. Future studies should investigate whether friendship support similarly predicts resilient psychosocial functioning after more severe childhood family experiences including a sufficient sample of adolescents with manifest histories of physical and sexual maltreatment in childhood that are not studied in this investigation.

In sum, we quantify resilient functioning by taking into account functioning across a range of psychosocial domains *and* individual childhood family experiences. We show that friendship support, but not family support, is an important positive predictor of both immediate and later resilient psychosocial functioning in adolescence and early adulthood. Therefore, interventions that promote the skills needed to acquire and sustain adolescent affiliate friendships may be crucial in increasing adolescent resilient functioning.

Acknowledgements

We would like to thank the NSPN sample for their participation. This study was designed and analysed by AlvH. The corresponding author (AlvH) had full access to the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. All authors contributed to the interpretation of the data, the writing of the paper, and approved the final manuscript.

Financial support

This work was supported by a strategic award from the Wellcome Trust to the University of Cambridge and University College London (095844/Z/11/Z), a Netherlands Organization for Scientific Research Rubicon grant (AlvH, NO 446-13-006), and a Royal Society Dorothy Hodgkin Fellowship (AlvH; No DH150176). Study data were collected and managed using REDCap electronic data capture tools hosted at the University of Cambridge. E.T.B. is employed half-time by the University of Cambridge and half-time by GlaxoSmithKline; he holds stock in GlaxoSmithKline. The funders had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; and preparation, review, or approval of the manuscript.

Conflicts of interest

None.

Ethical standards

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

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Supplemental material.
Friendships predict resilient psychosocial functioning across multiple domains in a healthy community cohort of adolescents

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Measures used to assess psychosocial functioning:

Psychopathology symptoms:

MFQ (Mood and Feelings Questionnaire)

The mood and feelings questionnaire(Angold *et al.* 1995) is a 33 item self-report questionnaire measuring current (past two weeks) depressive symptoms. As only 5 of the 33 items had an endorsement of the "always" category that was above 5%, we combined all "always" responses with "mostly" responses. In our sum score, higher scores indicated more severe depressive symptoms. At baseline, internal consistency of the MFQ was excellent (Cronbach's alpha=.93).

RCMAS (Revised Children's Manifest Anxiety Scale)

We assessed anxiety symptoms with the RCMAS self-report questionnaire(Reynolds & Richmond 1997). Responses ranged from either always, mostly, sometimes or never. The internal consistency for the total sumscore was excellent at baseline (alpha=.94).

S-LOI (Short Leyton Obsessional Inventory)

The LOI is an 11 item self-report questionnaire that measures obsessional/anxiety symptoms(Bamber *et al.* 2002). Responses ranged from 'always', 'mostly', 'sometimes' to 'never'. At baseline, the internal consistency for the sum score was good (alpha= .84).

K10 (Kessler Psychological Distress Scale)

We assessed psychological distress with the Kessler Psychological Distress scale (K10(Kessler *et al.* 2002; Furukawa *et al.* 2003)). Responses on the K10 range from "None of the time" to "All the time" along a five point scale. Internal consistency at baseline of the measure was very high (Cronbach's alpha=.89).

The behaviours checklist (BCL)

The behaviours checklist is an 11 item self-report questionnaire for symptoms of antisocial behaviour based on DSM IV conduct disorder items. Responses on these items ranged from 'always', 'mostly', 'sometimes' to 'never'. Endorsements on the "mostly" category were rare, with ten of the 11 items not reaching 5% of respondents, therefore, the "always" and "mostly" categories were combined. This measure has not been previously published. Internal consistency of the measure was good at baseline (Cronbach's alpha=.74).

Personality traits:

APSD (Antisocial Process Screening Device)

The Antisocial Process Screening Device is a 20 item scale measuring psychopathic traits(Frick *et al.* 2000). Responses on the APSD are "Not at all true", "Somewhat true" and "Certainly true". Internal consistency of the full measure was high with Cronbach's alpha (.73 for the entire sample), which indicates adequate internal consistency at baseline.

CADS (Child and Adolescent Dispositions Scale)

The Child and Adolescent Dispositions Scale(Lahey *et al.* 2008) was used to measure the dispositional traits: prosociability, negative emotionality and daring. Participants were ask to

rate items on how the description best describes them (answered: “not at all”, “just a little”, “Pretty much/pretty often” and “Very much/very often”). Internal consistency at baseline for the sum scores of these dimensions was good (i.e. prosociality alpha=.78, emotionality alpha=.72, and daring=.77).

ICU (Inventory of Callous-Unemotional Traits)

We used the Inventory of Callous-unemotional traits (ICU) to measure callous and unemotional traits(Kimonis *et al.*; Roose *et al.* 2010). Participants were asked how well a statement described them (responses given on a four point scale ranging from “Not at all true” to “Definitely true”). Internal consistency at baseline was good (Cronbach’s alpha = .82).

SPQ (Schizotypal Personality Questionnaire)

The Schizotypal Personality Questionnaire (SPQ) is a 74 item scale measuring schizotypal personality traits(Raine 1991). Responses on the SPQ are a yes or no endorsement. We used a total SPQ sum score where higher scores indicated more schizotypal symptoms. In NSPN, the internal consistency of the SPQ at baseline was excellent (Cronbach’s alpha = .94).

The Barratt Impulsivity Scale (BIS-11)

The Barratt Impulsivity Scale (BIS)(Stanford *et al.* 2009) is a 30 item scale measuring impulsivity personality traits. Participants were asked to think about how well each item describes how they act (responses range from “rarely” to “always”). We used the total sum score, where a higher score suggests more impulsivity. Internal consistency was good (Cronbach’s alpha=.82).

Mental Well Being

The Warwick-Edinburgh Mental Well Being Scale (WEMWBS)

Mental well-being was assessed with the Warwick-Edinburgh Mental Well Being Scale (WEMWBS)(Tennant *et al.* 2007). Participants were asked to respond to how well each statement described their experiences in the last two week (answers ranged from “none of the time” to “all of the time” on a 5 point likert scale). We used a total sum score as total WEMWBS score where higher scores indicate better mental well-being. Internal consistency for the WEMWBS was very high at baseline (Cronbach’s alpha = .92).

Table S1, Sample descriptives.

Time 1 (base-line) (N=1890):		Median	Mean	SD	SE	min	max
PSF	MFQ total score	15	17.54	11.54	0.27	0	64
	RCMAS total score	16	17.82	11.99	0.28	0	56
	LOI total score	3	4.77	4.84	0.11	0	32
	BEH total score	1	1.19	1.84	0.04	0	20
	k10 total score	8	9.46	7.02	0.16	0	39
	APSD total score	11	11.77	4.42	0.1	2	31
	CADS prosoc	42	41.04	5.36	0.12	18	52
	CADS negemot	15	15.19	3.83	0.09	7	28
	CADS daring	12	12.22	3.23	0.07	5	20
	SPQ total score	20	21.45	13.49	0.31	0	72
	WEMBS total score	50	48.63	9.42	0.22	16	70
	ICU total score	20	20.87	7.88	0.18	1	54
	BIS total score	61	61.78	9.91	0.23	34	102
	First component score	0.33	0	2.39	0.06	-9.17	5.33
Childhood family experi-ences	APQ positive	11	10.79	2.82	0.06	3	15
	APQ inconsistent	6	6.39	2.53	0.06	3	15
	APQ poorsup	6	6.52	2.58	0.06	3	15
	APQ involve	10	9.35	2.66	0.06	3	15
	APQ punish	3	3.72	1.59	0.04	3	15
	MOPS maternal abuse	0	0.89	1.86	0.04	0	15
	MOPS maternal indiff	0	1.08	2.26	0.05	0	18
	MOPS maternal control	3	3.15	2.55	0.06	0	12
	MOPS paternal abuse	0	1.29	2.63	0.06	0	15
	MOPS paternal indiff	0	2.08	3.91	0.09	0	18
	MOPS paternal control	2	2.34	2.4	0.06	0	12
	First component score	-0.48	0	2.03	0.05	-3.16	12.32

Table S2, Results principle component analyses for PSF and Childhood family experiences

N=1890	Psychosocial functioning (PSF)	Childhood family experiences	
First component			
SE	2.39		2.03
%var	0.44		0.37
Factor loadings:			
MFQ	-0.37	APQ positive parenting	0.33
RCMAS	-0.36	APQ inconsistent parenting	-0.13
LOI	-0.29	APQ poor supervision	-0.24
BEHTOT	-0.24	APQ involvement	0.33
K10	-0.35	APQ corporal punishment	-0.23
APSD	-0.25	MOPS maternal abuse	-0.35
CADS_Prosoc	0.12	MOPS maternal indifference	-0.34
CADS_NegEmo	-0.29	MOPS maternal control	-0.33
CADS_daring	-0.01	MOPS paternal abuse	-0.34
SPQ	-0.33	MOPS paternal indifference	-0.33
WEMBS	0.31	MOPS paternal control	-0.30
ICU	-0.23		
BIS	-0.24		

Regressions between relationship childhood family experiences and PSF

The relationship between childhood family experiences (CFE) on PSF. This relationship could be described as quadratic (Figure 1) (Est=-0.76, SE=0.03, t= -24.87, P<2e-16 & ^2: Est=0.05, SE=0.006, t=7.32, P=3.66e-13). This quadratic model fitted the data better (F(1,1887)=53.58, P=3.659e-13) than a linear model (Est=-0.61, SE=0.02, t= -26.45, P<2e-16, R^2=.27). In this quadratic relationship, childhood family experiences explained 29% of the variance in PSF. A cubic model (Figure S1) (Est=-0.76, SE=0.03, t= -24.82, P<2e-16 & ^2: Est=0.08, SE=0.014, t=5.97, P= 2.88e-09, ^3: Est=-0.004, SE=0.001, t=-2.94, P=.003), fitted the data slightly better than the quadratic model (F1,1886)=8.61, p=.003). However, the cubic model similarly explained 29% of variance, and there was only a marginal improvement when using Bayesian information criteria (BIC quadratic: 8043.466, BIC cubic: 8042.398). Therefore, for reasons of parsimony, we retained the quadratic model instead. Note that the cubic model revealed virtually identical results (see Table S3).

Table S3 predictors of resilient functioning as calculated from the cubic relationship between PSF and childhood family experiences.

Baseline		Est	beta	SE	t	Pr(>|t|)	
(N=1890)	Friendship	0.20	0.41	0.01	17.78	< 2e-16	***
	Family	0.02	0.07	0.01	2.85	0.00	**
	Age	0.05	0.07	0.01	3.30	0.00	***
	Gender	0.33	0.08	0.08	3.94	0.00	***
	SES	0.00	-0.01	0.00	-0.41	0.69	

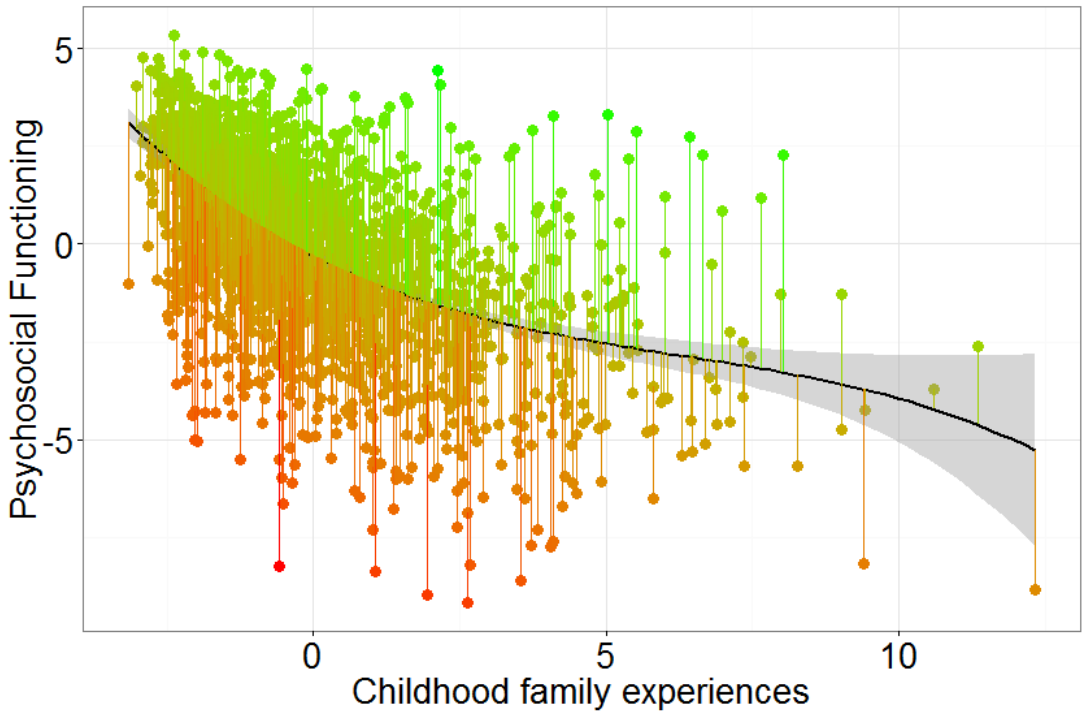
PCA for longitudinal analysis sample (N=1093)

For the longitudinal analyses we re-ran all analyses in the sample that had complete data on all measures at both times (N=1093). At time 1, the first component of a PCA for PSF explained 44% of variance. At time 2, a PCA revealed a first component that explained 46% of variance in PSF (see Table S5 for the loadings). Next we re-ran the PCA for childhood family experiences. To reduce the impact of the timing of the assessment on recall of childhood family experiences (Shaffer *et al.* 2008) we added both time points in one PCA. The resulting first component in this PCA explained 32% variance in the APQ and MOPS assessments at time 1 and 2 (Table S5). We then predicted PSF (time 1 *or* 2) from childhood family experiences in two separate regression analyses. Both models showed that childhood family experiences were a predictor of PSF of comparable magnitudes. At time 1 we found a quadratic relation between childhood family experiences and PSF (Est=-0.51, SE=.03, t=-16.56, p<2e-16, ^2: Est=0.02, SE=.005, t=4.16, p=3.38e-05, R^2adj=.24). This relation fit the data better than a linear relationship (F(1,1090)=17.34, P=.3.376e-05). A cubic relationship was not better than the quadratic relationship (F(1,1089)=0.07, p=.79). At time 2, a similar quadratic relationship was established between childhood family experiences and PSF (Est=-0.56, SE=.03, t=-17.68, p<2e-16,^2: Est=0.03, SE=.006, t=4.55, p=5.96e-06, R^2adj=.27). This model fits the data better than a linear model (F(1,1090)=20.71, p=5.957e-06), whereas a cubic model did not improve the model (F(1,1089)=.39, P=.53). From these regressions, we extracted individual residual scores at times 1 and 2 as a proxy for degree of resilient functioning.

Table S4, First components for PSF and childhood family experiences in N=1093.

N=1093	Psychosocial functioning		Childhood family experiences	
First component	T1	T2		T1&T2
SE	2.40	2.45		2.66
%var	0.44	0.46		0.32
Factor loadings:	T1	T2		T1 T2
MFQ	-0.37	-0.36	APQ positive parenting	0.25 0.25
RCMAS	-0.36	-0.36	APQ inconsistent parenting	-0.08 -0.08
LOI	-0.28	-0.27	APQ poor supervision	-0.16 -0.15
BEHTOT	-0.23	-0.23	APQ involvement	0.25 0.24
K10	-0.35	-0.35	APQ corporal punishment	-0.16 -0.16
APSD	-0.25	-0.24	MOPS maternal abuse	-0.25 -0.25
CADS_Prosoc	0.13	0.16	MOPS maternal indifference	-0.25 -0.25
CADS_NegEmo	-0.29	-0.27	MOPS maternal control	-0.22 -0.22
CADS_daring	0.01	0.01	MOPS paternal abuse	-0.24 -0.23
SPQ	-0.33	-0.33	MOPS paternal indifference	-0.23 -0.23
WEMBS	0.32	0.32	MOPS paternal control	-0.21 -0.20
ICU	-0.24	-0.25		
BIS	-0.24	-0.24		

Figure S1. The Cubic relationship between PSF and Childhood family experiences



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