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Unequal Social Belonging with Peers during Adolescence? Patterns by Age and Individual Characteristics

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Abstract

Social belonging, defined as temporally stable “frequent, affectively pleasant interactions with a few other people” (Baumeister & Leary, 1995, p. 497), is a fundamental human need and a crucial determinant of well-being. Despite its importance, gaps persist in our understanding of how social belonging to peers develops during adolescence and the extent to which social inequalities matter during this crucial life stage. This study addresses these gaps by investigating the development of social belonging to peers between the ages of 12 and 16, utilizing data from the kindergarten cohort of the German National Educational Panel Study. We employ fixed- and random-effects regression models to examine how students’ sense of social belonging changes as they grow older and how these developmental patterns differ by individual characteristics, i.e., gender, cultural and socioeconomic background, and academic achievement. Our findings reveal a slight decrease in social belonging between the ages of 12 and 16. Females report higher social belonging, although their decline over time is more pronounced than that of males. Students with a non-European cultural background do not show significantly higher belonging and differential growth trajectories compared to those with a European background. Adolescents from higher socioeconomic backgrounds start with slightly lower belonging at age 12 and show a somewhat gentler decline than their less advantaged peers, although this pattern is not robust across model specifications. We conclude that social inequalities in perceived levels of social belonging with peers persist throughout the earlier life stages, with some developing before adolescence.

Keywords Social Belonging · Developmental Trajectories · Social Disparities

1 Introduction

Adolescence represents a pivotal stage in the psychological and social development of individuals. During this transitional period, young people expand their social networks and actively seek social connections. This has a significant impact on their self-perception and interpersonal relationships (Brown & Larson, 2009). A central aspect of this period is the need for social belonging, which can be defined as temporally stable “frequent, affectively pleasant interactions with a few other people” (Baumeister & Leary, 1995, p. 497) and which plays a fundamental role in psychological well-being and social integration (Baumeister & Leary, 1995). Numerous studies have demonstrated that the experience of social belonging is closely linked to mental health, reduced risk of behavioral problems and stress, emotional resilience and self-esteem, loneliness, subjective well-being, achievement motivation, and educational outcomes (Allen et al. 2021a; Begen and Turner-Cobb 2015; Lim et al. 2021; Newman et al. 2007; Scarf et al. 2016) with evidence that positive effects of social belonging can be long-lasting (Walton & Cohen, 2011; Walton et al., 2012). Studies also show that social belonging is positively linked to physical health, such as reduced risk of disease (Cohen & Janicki-Deverts, 2009) and mortality (Holt-Lunstad et al., 2010). The trajectories of social belonging vary and can be shaped by many factors, including gender, cultural and socioeconomic background, and academic achievement (Grigorian et al., 2024; Painter, 2013). Adolescents from marginalized groups may, therefore, encounter challenges when striving for social belonging (Carter et al., 2023).

Social belonging typically means, for adolescents, being part of a peer group, with friendships playing a central role in this process. As adolescents spend much of their time at school and many of their peer relationships are established and maintained there, the school context is a key social environment in which adolescents interact. Consequently, much of the existing literature focuses on school belonging rather than adopting a broader perspective on adolescents’ social belonging across different contexts. Empirical research explicitly examining social belonging, however, remains scarce, and to our knowledge, no substantial body of literature exists that addresses this construct directly.

In the absence of such evidence, we draw on the literature on school belonging, defined by Goodenow and Grady (2010) as the extent to which students feel personally accepted and supported within the school environment, and which has been linked to academic achievement, well-being, and mental health among adolescents (Arslan, 2021; Pittman & Richmond, 2007). We rely on this literature not because it is conceptually equivalent to peer-related social belonging, but because, in the absence of a more directly applicable body of research, it constitutes the closest available source of empirical evidence exists, and findings from this literature therefore provide a valuable point of comparison for situating our results.

For general developmental patterns of school belonging, research consistently shows that school belonging declines during early adolescence (E.M. Anderman, 2002; L.H. Anderman, 2003; Ding & Hall, 2007), particularly around the transition to middle school (Eccles et al., 1993). This downward trend continues up to 10th grade, followed by a slight increase, although levels of belonging remain comparatively low

(Witherspoon & Ennett, 2010). However, it is unclear whether this trend also extends to adolescents' social belonging during this life stage in a broader sense, particularly in non-school settings.

Research further suggests potential variation in school belonging between sub-groups. Firstly, numerous studies suggest that females report higher levels of school belonging (Rostosky et al., 2003), which declines throughout high school, whereas levels remain rather stable for boys. As a result, female and male students had similar levels of school belonging by the end of high school (Gillen-O'Neel & Fuligni, 2013; Witherspoon & Ennett, 2010). Again, it can be questioned whether these patterns also manifest in adolescents' social belonging more broadly during this period of life, particularly beyond the school environment.

Whereas gender differences are more consistently reported, results regarding differences due to migration background in school belonging are less clear. Across OECD countries, patterns of school belonging among students with and without migration backgrounds vary considerably. In 29 of the 62 countries, students without a migration background reported higher levels of school belonging than their peers with a migration background, while the reverse was true in only three countries. In about half of the countries, no differences were observed. These variations appear to be shaped by the extent of institutional support available to migrant students (OECD, 2017). Such findings align with the idea that challenges for students with migration backgrounds often emerge when their cultural values and perspectives diverge from those of the mainstream culture (Ogbu, 1992). In the US context, Gopalan and Brady (2019) examined college students' sense of belonging among underrepresented racial-ethnic minorities compared to White, Asian, multiracial, and continuing generation peers, finding that underrepresented minorities reported lower levels of belonging. Similarly, Runa et al. (2023) employed self-report measures of ethnic minority identification among undergraduate science students to capture subjective understandings of ethnicity, while considering within-group differences and intersectionality. They found that a minority status negatively affected university students' sense of belonging, with notable intersectional variations within minoritized groups. From a cross-cultural perspective, Chiu et al. (2016) examined sense of belonging at school across different cultures, finding that students in more egalitarian cultures had higher school belonging than those in hierarchical cultures, while collectivistic cultures showed no association. Taken together, these findings underscore that belonging is shaped by broader cultural and institutional contexts, and that patterns differ markedly across settings and minority groups. Therefore, investigating social inequalities in general social belonging needs to consider adolescents' cultural background.

The socioeconomic background (SES) of students also plays an explanatory role in young people's sense of school belonging. Students from disadvantaged families experience less school belonging, while students from families with higher SES report higher feelings of school belonging (Allen et al., 2022; Chiu et al., 2016; De Bortoli, 2018). This holds true for almost every country (OECD, 2017), independent of the applied measures of SES. Similar effects were found on the sense of school belonging experienced by students in higher education (Trawalter et al., 2021). Nevertheless, less is known about individuals' trajectories of social belonging to peers according to SES.

School performance, as another important individual characteristic of adolescents, predicts a stronger sense of belonging to the school (L.H. Anderman, 2003). Similar patterns were found for academic performance and sense of belonging in college (Gopalan & Brady, 2019). Thus, levels of social belonging during adolescence might also vary between subgroups based on academic achievement.

Although extensive research has explored belonging within institutional settings, such as schools and colleges, there remains a significant lack of attention to young people's more general sense of belonging beyond these specific contexts. Social belonging is a broader construct encompassing an individual's overall sense of acceptance and connectedness in various social situations beyond educational institutions or particular settings. Understanding this general sense of belonging is crucial, as it can provide valuable insights into how adolescents navigate diverse social challenges and develop meaningful interpersonal connections within a broader societal context. Addressing this research gap could contribute to a more comprehensive understanding of adolescent developmental processes and their relation to well-being.

This study therefore investigates how social belonging develops during adolescence and how individual characteristics contribute to differences in levels and developmental trajectories of belonging contributing to a more nuanced understanding of how adolescents' social belonging evolves, both in a general sense and in relation to specific individual characteristics. We investigate systematic variation by individuals' gender, cultural and socioeconomic background, and academic achievement. To this end, we draw on longitudinal data from Germany to examine age-related trajectories of social belonging and to investigate how these trajectories differ according to individual characteristics.

2 Theoretical Framework

2.1 General Framework

Various factors and contextual circumstances influence social belonging. To understand the antecedents and environments in which social belonging can thrive and develop, we refer to the comprehensive framework proposed by Allen et al. (2021b). According to this framework, social belonging depends on four primary components: competencies, opportunities, motivations, and individual perceptions (see Fig. 1). These components overlap considerably and are intertwined.

Competencies refer to the set of skills and abilities that are essential for connecting with others and experiencing a sense of belonging. These include both cultural and social competencies (Allen et al. 2021b). Cultural competence encompasses the ability to understand and respect the heritage, norms, and values of others (Ward & Szabó, 2023). At the same time, social competencies involve skills such as emotional and behavioral regulation, awareness of others, effective communication (both verbal and nonverbal), and adherence to social norms. These competencies are crucial as they enable individuals to interact meaningfully with others, build social relationships, such as friendships, and ultimately experience a sense of social belonging (Booker & Dunsmore, 2017).

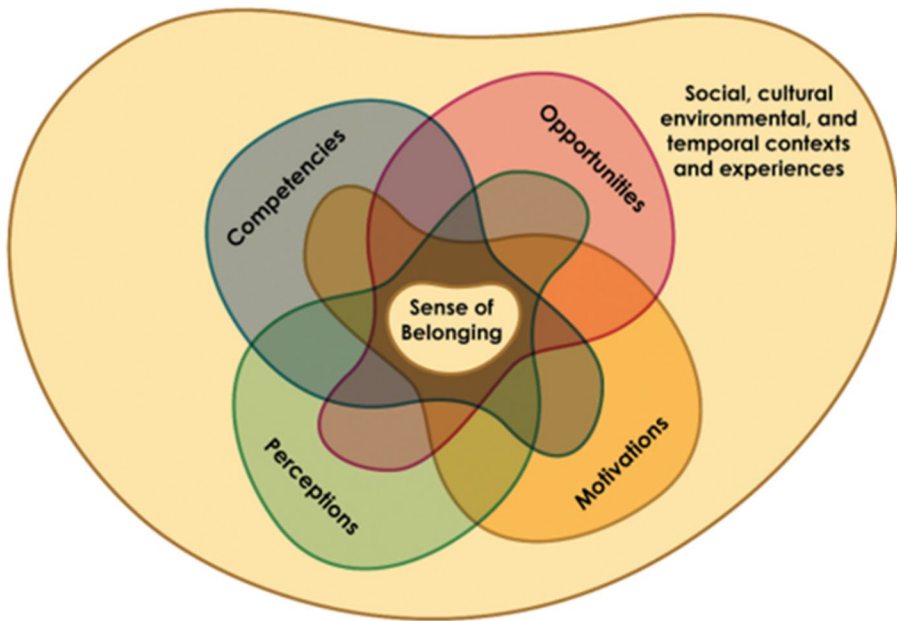


Fig. 1 General framework of social belonging (Allen et al. 2021b)

Opportunities are another critical element, representing the availability of contexts and spaces where individuals can connect with others and form friendships. These opportunities might arise in various social settings such as schools, neighborhoods, extracurricular activities, and volunteer organizations (Winstone et al., 2022). The presence of such opportunities is vital, as they provide an environment where individuals can apply their competencies to forge connections and relationships. Conversely, a lack of access to these opportunities can pose a significant risk to social belonging, even if individuals possess the necessary competencies and willingness to connect.

Motivations pertain to the intrinsic need of individuals to be accepted, to belong, and to engage in social interactions and friendships. While the need for social belonging is a fundamental human drive, the level of motivation can vary significantly among individuals, leading to differences in the effort they invest in forming social connections and, consequently, to the extent to which individuals are socially integrated in friendships (Leary & Kelly, 2009). The motivation to feel a sense of social belonging is, therefore, an essential component that determines the direction of one's actions in achieving the desired outcome.

Finally, individual *perceptions* play a decisive role in the experience of social belonging (Allen et al. 2021b). These perceptions are closely linked to personal motives and previous experiences and can vary greatly from person to person. For example, the individual's need for social belonging is central to assessing their current state. A person with a high need for social belonging will rate it as inadequate if they cannot achieve their high level of social belonging. Conversely, someone with significantly fewer social contacts, interactions, and friends may be highly satisfied

with their social belonging if this already meets their needs. In addition, a person's past experiences, particularly those involving social rejection, can significantly influence their perception of their current sense of belonging, even if their objective level of social integration is similar to others (Pardede & Kovač, 2025). The subjective nature of social belonging, therefore, means that individuals may evaluate their belonging differently depending on their individual needs and experiences.

Overall, social belonging is deeply embedded within social, cultural, environmental, and temporal contexts. These contexts influence the levels of competence, opportunity, motivation, and perception that individuals possess, suggesting that any investigation into social belonging must consider the broader environment in which an individual is situated.

2.2 Age-Related Development of Social Belonging

Building on the framework outlined by Allen et al. (2021b), we expect age-related differences to emerge in individuals' levels and evaluation of their social belonging in the context of peer relationships. These differences arise because, as individuals age, there are ongoing changes in their competencies, opportunities, motivations, and perceptions, which we will now explore in more detail. First, we expect that competencies for social interaction increase with age, as both verbal and nonverbal communication skills develop substantially during adolescence (Law et al., 2008). In general, academic competences increase over childhood and adolescence, and their development is positively associated with social competencies (Welsh et al., 2001). Thus, social competencies, such as emotional regulation, also tend to improve as individuals mature (e.g., Cracco et al., 2017). The same may also apply to individuals' cultural competence. Studies have shown that social interactions vary significantly across different cultures (Chen et al., 2011). Thus, increased contact between children from different cultures over time has the potential to result in higher levels of cultural competence. These developments suggest that older individuals should be better equipped to connect with others and maintain social relationships, such as friendships, thereby enhancing their sense of social belonging.

Second, opportunities to connect with others also change with age, often expanding as individuals transition through different stages of life. For example, the transition from kindergarten to primary school, and later to secondary school, introduces new social contexts that provide fresh opportunities to form connections, such as new friendships (Crosnoe, 2011). Similarly, as individuals take up new hobbies or interests, they may join new social groups, such as extracurricular activities, thereby further increasing their opportunities for social belonging (Winstone et al., 2022). Thus, in the early stages of life, aging is generally associated with an increase in opportunities to form friendships, leading to higher levels of social belonging with their peers.

Third, motivations to belong evolve as individuals age, influenced by changing social norms and expectations. In early childhood, social belonging is predominantly centered around family relationships. However, as individuals enter adolescence, the importance of peer relationships increases significantly (e.g., Drolet & Arcand, 2013) and closeness to family members diminishes (e.g., Steinberg, 1987; Buhl, 2008). During adolescence, extrafamilial relationships begin to fulfill many of the functions

previously served by family, reflecting a shift in normative values. The heightened importance of peer connections during this stage of life is underscored by qualitative research, which indicates that adolescents place a high value on positive peer relations and feel a strong need to be socially integrated (Drolet & Arcand, 2013). Heightened motivation for social belonging, particularly within peer contexts, represents a central developmental feature of adolescence.

Finally, individual perceptions of social belonging may also undergo significant changes during adolescence. This period, marked by puberty, is associated with emotional upheavals, physical changes, and developmental challenges, all of which can influence how adolescents perceive their social belonging (Laursen & Hartl, 2013). The shift from a family-centered to a peer-centered reference group can lead to a re-evaluation of social belonging, with adolescents potentially feeling less socially connected if they do not have the peer relationships, i.e., friendships, they desire. For example, time spent with some single same-sex friends, which was previously seen as desirable, might now be perceived as social isolation (Laursen & Hartl, 2013). Thus, the perception of social belonging according to peer relationships becomes more complex during adolescence, as individuals navigate the changing social landscape and their evolving social needs.

Taken together, these considerations suggest that adolescents' sense of social belonging undergoes substantial transformation during this developmental period. Given the increase in competence levels among individuals, the prospect of new opportunities for connection, as well as the increase in motivation, it would be reasonable to hypothesize that social belonging levels will rise during this life period. However, the shift in social norms regarding social connectedness and the upcoming challenges of experiencing social belonging might result in the opposite. As young people may no longer be able to fulfill their need for social belonging through their family relationships, while simultaneously being unable to fully substitute family relationships with those of peers, a sense of loneliness may emerge that is incongruous with a perception of social belonging. Consequently, it is plausible that the assessment of what was previously adequate, e.g., the number of friends, is now more unfavorable. Therefore, we expect that during adolescence, individuals experience a decrease in their social belonging with peers (**H1**).

3 Heterogeneities by Individuals' Characteristics

Despite the general negative trend in individuals' feelings of social belonging during adolescence, we also expect heterogeneity in this development based on individual characteristics. One significant source of variation is *gender*, as males and females may exhibit differential patterns in their perceptions and motivations regarding social belonging and peer interactions (e.g., Allen et al. 2021b; Almquist et al. 2014; Neal 2010; Rustin and Foels 2014; Rose and Rudolph 2006). Research indicates that males and females show different tendencies towards the breadth and depth of their social connections. Males seem to be more often oriented towards broader social networks, engaging in peer relationships characterized by lower levels of intimacy (Baumeister & Sommer, 1997; Titzmann & Jugert, 2021). For example, boys might prefer to

participate in group activities, such as team sports or large social gatherings, where they can interact with many peers simultaneously, forming numerous, albeit less profound, social connections. This tendency may reflect a preference for diverse social contacts and a focus on status or social standing within larger groups, rather than seeking deep emotional connections with a few close friends.

In contrast, females are often described as placing more emphasis on close and supportive social relationships and may be more likely to focus on a smaller number of emotionally close bonds (Baumeister & Sommer, 1997; Titzmann & Jugert, 2021). For instance, girls might place a higher value on having a best friend or a small group of confidants with whom they can share personal thoughts and feelings. This pattern suggests that emotional closeness and support may play a particular role in females' social interactions. Because these relationships carry more emotional weight, disruptions such as conflict or exclusion may be more strongly associated with girls' evaluation of their social belonging. During adolescence, when peers increasingly become important social reference points, these processes may become especially salient. Girls, who may rely more strongly on close friendships as a source of emotional support, could therefore be more vulnerable to experiencing loneliness or declines in social belonging when these relationships are disrupted. In contrast, given boys' assumed preferences for broader social networks, they should demonstrate lower vulnerability to emotional distress about social relationships during adolescence (Newman et al., 2007). Taken together, these patterns suggest that girls may be more likely to experience fluctuations in their social belonging during this developmental period.

Females tend to enter puberty earlier than males and are more likely to experience early maturation (e.g., Marceau et al., 2011; Partsch, 2001). This earlier onset of puberty can be accompanied by a higher prevalence of depressive symptoms and emotional distress, reflecting the increased emotional and psychological challenges that girls may face (e.g., Graber et al., 1997; Hayward & Sanborn, 2002; Marceau et al., 2011). As a result, girls may experience periods in which they feel less connected to their peers. Although considerable individual variation exists, these developmental processes could contribute to earlier or stronger declines in perceived social belonging among girls compared to boys. Therefore, based on the aforementioned arguments, we hypothesize that social belonging levels decrease more strongly for girls compared to boys during adolescence (**H2**).

A second potential factor contributing to individual differences in adolescents' social belonging is *cultural background*. While children across cultural contexts share many developmental processes, distinct cultural socialization practices systematically shape their social competencies, motivations, and perceptions of belonging. For instance, cultural differences in parenting values influence the development of self-regulation and socio-emotional competencies (Chen et al., 2011), which are foundational for social integration. Moreover, cultures differ in the value placed on peer interaction and play. Parents in Western societies, for example, often assign considerable developmental importance to children's play and peer relationships, viewing them as essential for social and emotional growth. In contrast, some non-Western contexts emphasize obedience, family cohesion, or academic achievement over peer-centered interaction (Chen et al., 2011). However, as Chen et al. (2011) note, this does not imply that social connectedness is less important in these cultures; rather,

its expression and meaning differ. In many collectivist societies, belonging is fostered through strong family bonds and group interdependence, leading to a different, but not necessarily weaker, orientation toward social relationships. Consequently, adolescents from different cultural backgrounds may differ in their experiences and perceptions of belonging depending on how their cultural background conceptualizes and prioritizes social connectedness to peers. These differences could manifest themselves in either a higher or lower degree of perceived belonging among peers, depending on the extent to which the family's socialization practices are consistent with the peer culture of the host society. In addition, differences are likely to increase over time as trajectories create path dependencies. For example, the longer the orientation towards other groups persists, the weaker the integration into social bonds with peers becomes. Therefore, we hypothesize that trajectories of social belonging may vary by cultural background, with the direction and magnitude of differences shaped by underlying cultural orientations toward social relationships (**H3**). We refrain from stating directional hypotheses for different groups of cultural backgrounds because groups remain relatively broad and internally diverse.

Moreover, a third factor may influence the trajectories of social belonging. Previous research has found a significant relationship between adolescents' sense of social belonging and their *parents' SES* (Sirin, 2005; Rubin & Kelly, 2015; Reay, 2005; Goodenow, 1993; Burger & Brack, 2025). People from higher socioeconomic backgrounds often have better access to resources that enable them to open up various opportunities for social contact (e.g., memberships in voluntary associations and group activities). Those resources can translate into opportunities such as extracurricular activities and social networks, which facilitate the development of social belonging. Participation in these activities has been found to enhance peer relationships, which are crucial for adolescents' sense of social belonging (Covay & Carbonaro, 2010; Fredricks & Eccles, 2006). Furthermore, parents with higher SES are more likely to foster children's social belonging due to higher levels of parental involvement in this developmental period (Roksa & Potter, 2011). Therefore, socioeconomic factors may have a profound influence on the development of social belonging in adolescents. By providing resources, parents with higher socioeconomic status can promote and better support their children's social integration during critical periods. Consequently, we hypothesize that the decline in social belonging levels is less pronounced for those students living in families with a higher SES background (**H4**).

A fourth moderator, affecting the individuals' social belonging levels, is *academic achievement*. Academic achievement generally reflects an individual's competence levels, such as verbal skills, and thus can be linked to their ability to connect and maintain relationships with others. Higher academic achievement can indicate stronger competencies in communication and social interaction, which are critical for building and sustaining long-lasting social relationships (Nilsen & Bacso, 2017; Bellanti & Bierman, 2000). As a result, students with higher academic achievement may experience higher levels of social belonging, as they are often better equipped to navigate social dynamics and establish meaningful connections.

These differences in social belonging may widen over time, as lower levels of social belonging can hinder cognitive and social development during adolescence (Huang, 2022), thereby further widening the gap in competencies necessary for

social integration. This suggests that students who struggle academically may face compounded challenges, with lower social belonging contributing to a cycle of diminished social skills and academic performance, leading to increasingly divergent levels of social belonging among peers as adolescence progresses. As a result, we hypothesize that the social belonging levels of individuals during adolescence decrease to a lesser extent for those with higher academic achievement compared to their lower-achieving counterparts (**H5**).

4 Empirical Strategy

4.1 Data

To investigate social inequalities in the development of social belonging with peers during adolescence and its heterogeneity, we analyzed data from the Starting Cohort 2 (Preschoolers, SC2) of the National Educational Panel Study (NEPS) in Germany (NEPS Network, 2024; Blossfeld & Roßbach, 2019). The sample includes children who were first observed at the age of 4 in 2010 in day-care facilities, as well as children who were first observed in grade 1 in regular schools (refreshment sample). The annual survey collects information on educational progress, cognitive skills, living conditions, parents' education and employment, and the well-being of children. In waves 2018/2019, 2020/2021, and 2021/2022¹, questions related to children's sense of social belonging with peers were included. Thus, this study focuses on the respective waves while also utilizing time-constant information from previous survey waves, such as parental characteristics. We included all children who were observed at least once during the observation period and addressed missing information using multiple imputation by chained equations ($m=20$ datasets), following the procedure proposed by Zinn and Gnambs (2018), to reduce bias due to sample attrition and item nonresponse.² To ensure sufficient representation of all age groups, we focused on adolescents aged 12 to 16 during our observation period. Additionally, we only included students who did not change schools within this timeframe to maintain consistency in contextual factors. The imputation sample comprised 4,333 individuals, corresponding to 10,721 unimputed person-year observations.

4.2 Methods

To identify the age-related development of social belonging with peers and the heterogeneity by individual's characteristics, we used fixed-effects (FE) panel regression models grounded in the following basic model:

¹ Data collection was conducted during three periods: from October 2018 to May 2019 (2018/2019), from October 2020 to January 2021 (2020/2021), and from June 2021 to March 2022 (2021/2022).

² We also estimate our models based on individuals who are observed at least twice in our observation period without imputation (see Table 5 Appendix A). Results differ in some parts from our main analyses. In the case of gender, the coefficients are somewhat smaller compared to our main analyses, however, they remain significant. In addition, the age effect is also confirmed.

$$Social\ belonging_{it} = age_{it}\beta + \alpha_i + \epsilon_{it} \quad (1)$$

The basic model reflects the linear relationship between the dependent variable (*Social belonging_{it}*), and independent variables (*age_{it}*) repeatedly measured across subjects and over time.³ It has two error components, one representing the time-constant error term (α_i), which reflects time-constant individual characteristics and living conditions, and an idiosyncratic error term, which varies over time and between subjects (ϵ_{it}). Fixed-effects regression models, however, only use the variation within subjects to predict changes in *Social belonging_{it}* due to changes in *age_{it}*. This procedure eliminates time-constant confounding factors and, consequently, reduces bias due to unobserved heterogeneity in the baseline trend (Brüderl, 2010).

To investigate heterogeneity by individual characteristics (e.g., gender, cultural and socioeconomic background, academic achievement), we first examined mean differences in social belonging using a random-effects (RE) regression model. This model provides an initial descriptive assessment of between-group differences in social belonging level as well as age-related patterns. Second, to test whether age-related changes in social belonging vary across these characteristics, we extended our individual fixed-effects models by including interaction terms between age and the respective moderators. The resulting model can be expressed as follows:

$$Social\ belonging_{it} = age_{it}\beta_1 + age_{it} * moderator_i\beta_2 + \alpha_i + \epsilon_{it}$$

FE models do not estimate the main effect of time-invariant variables (*moderator_i*), but the interaction term (*age_{it} * moderator_i*) allows us to assess whether the *slope of social belonging across age* varies systematically by these characteristics. Positive or negative interaction coefficients indicate that the rate of change in social belonging differs between groups defined by the moderator.

4.3 Operationalization

Social Belonging with Peers To investigate individuals' trajectories in social belonging during adolescence, we use a measure reflecting individuals' social belonging to generalized others, such as friends. This concept refers to the theoretical construct described by Baumeister and Leary (1995). In line with the German Youth Institute (2010), children are asked whether they agree with the following statements: (1)

³ To assess whether the association between age and social belonging is nonlinear, we estimated an alternative model including age dummy variables. The results revealed a pattern of age effects that was highly comparable to that obtained from the linear specification. The age effects are similar from age 12 to 13 and from age 14 to 15, but more pronounced from age 13 to 14 and somewhat smaller from age 15 to 16. However, these differences are small in magnitude; therefore, for ease of interpretation of the interaction effects, we retain the linear model in the main analyses, while presenting the results from the nonlinear specification in Appendix C (Table 9 and Figure 7).

I find it easy to make new friends; (2) I often feel lonely; (3) I would like to have more contact to other people; (4) We do a lot together in my circle of friends; (5) In my circle of friends, I find support when I have worries and problems. Values ranged from 1 “does not apply at all” to 5 “does totally apply” (for more detailed information on the measurement, see Bömmel et al., 2022). We reversed item two to be in line with all other items. We employed latent variable analyses to assess the validity of the scale. In doing so, we decided to use only items one, two, four, and five, because item three stands out in terms of content, as it can represent both the desire for more friends and, conversely, the need to be alone. In conjunction with the other items from the scale, it therefore does not represent the feeling of social belonging. This is also confirmed in the corresponding factor analyses (see Table 4 in Appendix A). We also tested longitudinal measurement invariance as prerequisite for comparing means between measurement occasions, largely indicating measurement reliability between time points.⁴ For analysis, we use the mean of the remaining items reflecting an individual’s overall level of social belonging according to friends.⁵ The social belonging level ranges from 1 to 5, with 1 reflecting no social belonging and 5 full social belonging. On average, individuals reported a social belonging level of approximately 3.8 over the observation period (see Table 3 in Appendix A).

Gender and Cultural Background We used information on children’s sex provided by schools and generated a dummy variable coded “1” for females and “0” for males. Our sample consists of approximately 52% female students. To assess heterogeneity by cultural background, we created a categorical variable indicating children’s cultural background. This variable differentiated between the largest groups in the NEPS dataset: European (including German), Russian/post-Soviet, Central Asian/Islamic, Asian, and those not belonging to these groups or with missing information in the relevant variables. We operationalized children’s cultural background using parents’ country of birth, as reported independently by parents or children. Children whose parents shared the same country of birth were assigned to that corresponding cultural background category. In cases where parents’ countries of birth differed, we applied a hierarchical coding rule: if one parent was born in Germany or elsewhere in Europe, the child was classified as having a European/Western background, reflecting the assumption that such children are socialized into Western European cultural norms both within and outside the family context. Where neither parent had a European background, and the two differed from one another, children were classified into a mixed-background category. Approximately 92% of our sample has a European background (including German), 3% have a Russian/post-Soviet background, and about 2% have a Central Asian/Islamic background. Only a small percentage of the sample have an Asian or other cultural background, and about 2.5% grew up in a family with more than one (non-European) culture (see Table 3 in Appendix A).

⁴ Results are available upon request.

⁵ As a robustness check we also predicted a factor score based on structural equation modelling (for results of the SEM models please refer to Table 6 and 7 in the Appendix B). The empirical results for age effects are similar to our main results, the gender differences are slightly smaller though (see Table 8 in Appendix B).

Socioeconomic Background For investigating heterogeneity by children's socioeconomic background, we refer to information on parents' occupational status. We utilized information on the ISEI-08 ratings of both fathers and mothers, which range from 11.74 to 88.96. The ISEI-08 rating assesses parents' socioeconomic status, encompassing their occupational status and income levels. Thus, the ISEI represents economic and social resources available in families. We defined children's socioeconomic background using the higher ISEI value of either the mother or the father. The average ISEI in our sample is 64.42 (see Table 3 in the Appendix A).

Academic Achievement To explore whether age effects on social belonging diverge by individuals' academic achievement, we utilize data on reading and mathematical competencies (for more details, see Gehrler et al., 2013; Neumann et al., 2013), as provided by the NEPS. Both tests contain a maximum of 33 items, and 28 min are granted for completion. Test scores are scaled as conditional probabilities of achieving a given ability level based on Rasch models (Fischer et al., 2016). We use competence scores assessed in grade four, as these capture academic achievement prior to the observation period and are thus unaffected by any subsequent development in social belonging over the course of the study. Based on these scores, we constructed a three-category achievement variable. Respondents scoring below the sample's 25th percentile in both competence domains were classified as "low achievers" (1). Respondents scoring in the 75th percentile or above in at least one domain, with no score below the 25th percentile in either domain, were classified as "high achievers" (3). All remaining respondents, those with at least one domain score in the intermediate range, were classified as "average achievers" (2). About 9% of the sample had low academic achievement in fourth grade, compared with 47% with average achievement and 44% with high achievement (see Table 3 in Appendix A).

Confounding Factors The age-related development of social belonging may be confounded by factors that change with age and may also affect our outcome, social belonging. These are period effects corresponding to the onset of the COVID-19 pandemic and mode differences within the panel survey. Therefore, we included in our model a dummy variable indicating responses before and during the COVID-19 pandemic, as well as an indicator for response mode (online survey vs. paper-and-pencil questionnaire). In our random-effects models, we also control for social demographics as well as sample characteristics. Depending on the moderator included, the following variables are considered: gender, cultural background, socioeconomic background, ability levels, federal state of living, and attendance at a higher secondary school, i.e., the academic school track in Germany.

5 Results

5.1 Baseline Results for Age-Effects on Social Belonging

In the following section, we present results addressing our research question, how social belonging develops throughout adolescence. We start by presenting our base-

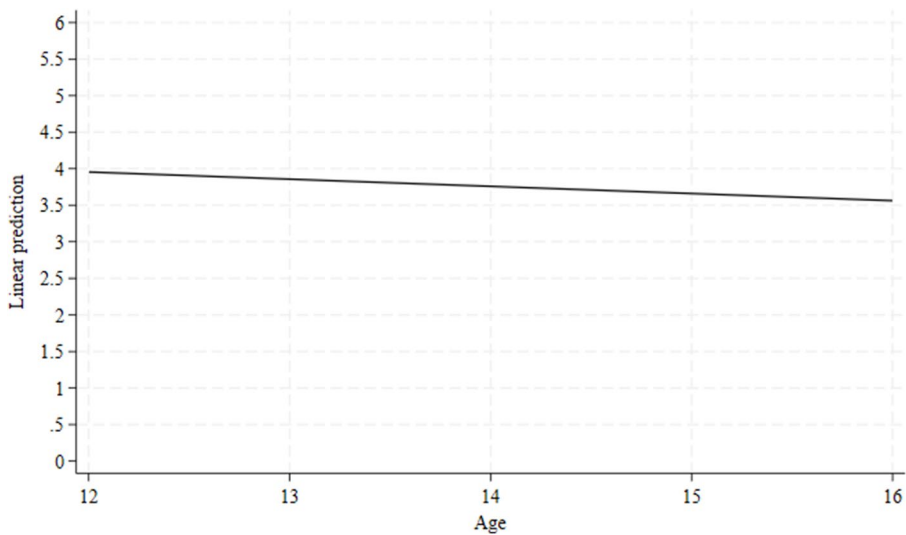


Fig. 2 Age Effects on Social Belonging by Individual Characteristics-Nonlinear Age Effects (Fixed-Effects Regression)

Source: NEPS SC2 (<https://doi.org/10.5157/NEPS:SC2:11.0.0>); N=4,333. Note: Linear predictions based on the FE-model. Figures present predictions based on multiple imputed data in Stata (Package `mimrgn`). Since confidence intervals are not correctly predicted in the marginsplot, we did not integrate them into the Figures presented. However, correct standard errors are shown in Table 1 for more detailed information

line results estimated with a fixed-effects panel regression model. As depicted in Fig. 2; Table 1, we observe a small negative trend in individuals' social belonging levels between the ages of 12 and 16. Social belonging with peers decreases by about 0.1 score points per year. This means that an individual who reported full social belonging at the beginning of the period experienced a decrease by about 0.5 scale points on the original social belonging scale. This supports our first hypothesis, showing a decrease in social belonging with peers throughout adolescence.

Table 1 Age Effects on Social Belonging (Baseline Results)

Age	Social belonging
	-0.0982***
	(0.0159)
_cons	5.139***
	(0.195)
Observations	12,935
N	4,333

Source: NEPS SC2 (<https://doi.org/10.5157/NEPS:SC2:11.0.0>); N=4,333.

Note: Controlled for COVID-19 pandemic period and survey mode, standard errors in parentheses, $^+p < 0.10$, $^*p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

5.2 Heterogeneity by Individuals' and Background Characteristics

We now move on to the systematic variation in social belonging by individual characteristics. We investigated the differences using random-effects regression models to gain initial insights into the mean differences between subgroups and age-related patterns by complementing these first results with fixed effects regression models. Our results indicate significant differences between females and males in terms of their social belonging levels and developmental progress during adolescence (see Table 2, columns 2 and 3, and Fig. 3). In the random-effects model, the social belonging score of females is about 1.20 points higher than that of their male counterparts. This coefficient represents the estimated difference between females and males at the baseline of the model ($\text{age}=0$). By the age of 12, this difference amounts to approximately 0.14 score points.⁶ This suggests that, prior to the start of the observation period as well as at the beginning, females had a higher level of social belonging. However, females demonstrate a more pronounced decline in their sense of social belonging during the observation period. With each additional year, their perceived social belonging decreases by about 0.13 score points ($\beta = -0.127$ [Age: -0.039 , Female $\times$ Age: -0.0878]). In contrast, males show a smaller annual decline of about 0.04 score points. As demonstrated by the fixed-effects regression models, these age-related trends are largely confirmed (females: $\beta = -0.130$ [Age: -0.0605 ; Female $\times$ Age: -0.0694]; males: $\beta = -0.0605$). Both models suggest that, by the end of the observation period at age 16, females experienced a lower level of social belonging. Taken together, these results support our second hypothesis, demonstrating a more pronounced decline in social belonging levels of females.

Secondly, our results provide tentative indications that adolescents' cultural background may be related to their levels of social belonging (see Table 2, columns 4 and 5, and Fig. 4), although none of the coefficients are statistically significant. The baseline patterns suggest that adolescents with a non-European background tend to report somewhat higher levels of social belonging with their peers than those with a European background. In particular, adolescents with an Asian (non-Islamic) background, as well as those whose cultural background does not fall within one of the major predefined cultural groups, show descriptively higher initial levels of social belonging at the beginning of the observation period. However, the relatively large standard errors indicate a high degree of uncertainty around these estimates and should therefore not be interpreted as robust group differences. This uncertainty may partly reflect the relatively small number of adolescents within some cultural background categories and the considerable heterogeneity within these groups, which likely limits statistical precision.

Third, we observe some small, though not fully consistent, differences in adolescents' social belonging by socioeconomic background (see Table 2, columns 6 and 7, and Fig. 5). The random-effects models suggest that higher parental socioeconomic status is associated with slightly lower levels of social belonging at the models' baseline ($\beta = -0.0061$), and indicate that adolescents with higher parental socioeconomic status show a somewhat less pronounced decline in social belonging as they

⁶ Predicted margin at age 12 based on random-effects model.

Table 2 Age Effects on Social Belonging by Individual Characteristics

	Gender		Cultural Background		Parental ISEI		Achievement Level in Grade 4	
	RE	FE	RE	FE	RE	FE	RE	FE
Age	-0.0385** (0.0131)	-0.0605** (0.0184)	-0.0835*** (0.0122)	-0.105*** (0.0144)	-0.116*** (0.0235)	-0.0649 (0.0528)	-0.0787*** (0.0134)	-0.0771** (0.0192)
Female (ref.: male)	1.193*** (0.139)							
Female x Age	-0.0878*** (0.0102)	-0.0694** (0.0263)						
Cultural Background (ref.: -European (incl. German))								
<i>Russian-post soviet</i>			-0.305 (0.443)					
<i>Central-Asian/Islam</i>			0.464 (0.504)					
<i>Asian</i>			1.205 (1.061)					
<i>All other</i>			1.055 (1.741)					
<i>Mixed</i>			-0.0424 (0.458)					
Cultural Background x Age (ref.: European (incl. German))								
<i>Russian/post-Soviet x Age</i>			0.0218 (0.0326)	0.0703 (0.0838)				
<i>Central-Asian/Islam x Age</i>			-0.0296 (0.0374)	0.0237 (0.0996)				
<i>Asian x Age</i>			-0.0882 (0.0808)	0.223 (0.287)				
<i>All other x Age</i>			-0.0721 (0.130)	0.202 (0.365)				

Table 2 (continued)

	Gender		Cultural Background		Parental ISEI		Achievement Level in Grade 4	
	RE	FE	RE	FE	RE	FE	RE	FE
<i>Mixed x Age</i>			0.00889 (0.0332)	0.145 (0.0956)				
Parental ISEI					-0.00610 (0.00412)			
Parental ISEI x Age					0.000516 ⁺ (0.000297)	-0.000490 (0.000789)		
Achievement Level in Grade 4 (ref.: Average Achiever in Grade 4)								
<i>Low Achiever</i>							0.240 (0.276)	
<i>High Achiever</i>							-0.0134 (0.144)	
Achievement Level in Grade 4 x Age								
<i>Low Achiever x Age</i>							-0.0218 (0.0199)	-0.0424 (0.0557)
<i>High Achiever x Age</i>							-0.00615 (0.0104)	-0.0371 (0.0274)
_cons	4.226 ^{***} (0.180)	5.123 ^{***} (0.167)	4.854 ^{***} (0.166)	5.128 ^{***} (0.167)	4.788 ^{***} (0.182)	5.128 ^{***} (0.167)	5.305 ^{***} (0.320)	5.118 ^{***} (0.166)
Controls	YES	YES	YES	YES	YES	YES	YES	YES
N	4,333	4,333	4,333	4,333	4,333	4,333	4,333	4,333
Observations	12,935	12,935	12,935	12,935	12,935	12,935	12,935	12,935

Source: NEPS SC2 (<https://doi.org/10.5157/NEPS.SC2:10.0.0>)

Note: Standard errors in parentheses; ⁺ $p < 0.10$, ^{*} $p < 0.05$, ^{***} $p < 0.01$, ^{****} $p < 0.001$; controls for RE models include: COVID-19 pandemic, response mode, gender, cultural background, socioeconomic background, ability levels, federal state of living and attendance at a higher secondary school; controls for FE models include: COVID-19 pandemic, response mode.

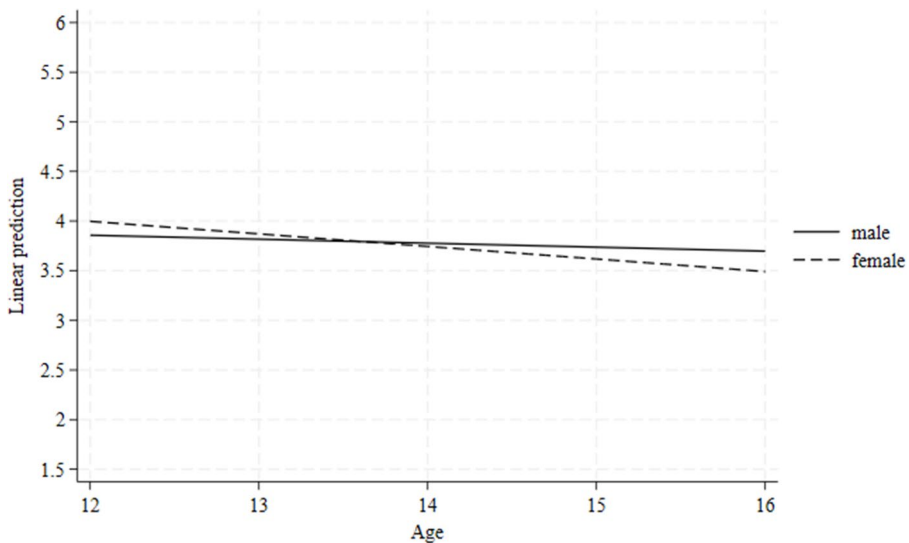


Fig. 3 Age Effects on Social Belonging by Gender

Source: NEPS SC2 (<https://doi.org/10.5157/NEPS:SC2:11.0.0>); N=4,333. Note: Linear predictions based on the FE-model. Figures present predictions based on multiple imputed data in Stata (Package `mimrn`). Since confidence intervals are not correctly predicted in the marginsplot, we did not integrate them into the Figures presented. However, correct standard errors are shown in Table 1 for more detailed information

grow older. Specifically, with each additional point on the ISEI scale, individuals show approximately 0.0005 fewer points of decline in their social belonging levels per year compared to the average, though this interaction effect is only significant at the 10% level. This would imply, for example, that adolescents whose parents have an ISEI score of about 80 experience roughly a 0.025 score point smaller decrease in social belonging compared to those whose parents have an ISEI of about 30. However, this pattern is not confirmed in the fixed-effects regression models: here, the interaction effect with age becomes smaller in magnitude, turns negative, and is statistically non-significant. Given this lack of robustness across model specifications, these findings should be interpreted with caution. Taken together, the results suggest that, once time-constant factors are accounted for, we do not find consistent evidence that a higher parental socioeconomic status provides additional resources that protect adolescents' perceived social belonging compared to those from lower socioeconomic backgrounds, and we are therefore unable to confirm our fourth hypothesis.

Finally, we do not find statistically significant differences in adolescents' social belonging by achievement levels measured in grade four (see Table 2, columns 8 and 9, and Fig. 6). Descriptively, adolescents with higher achievement levels appear to report slightly lower initial levels of social belonging, though this difference does not reach statistical significance compared to those with average achievement lev-

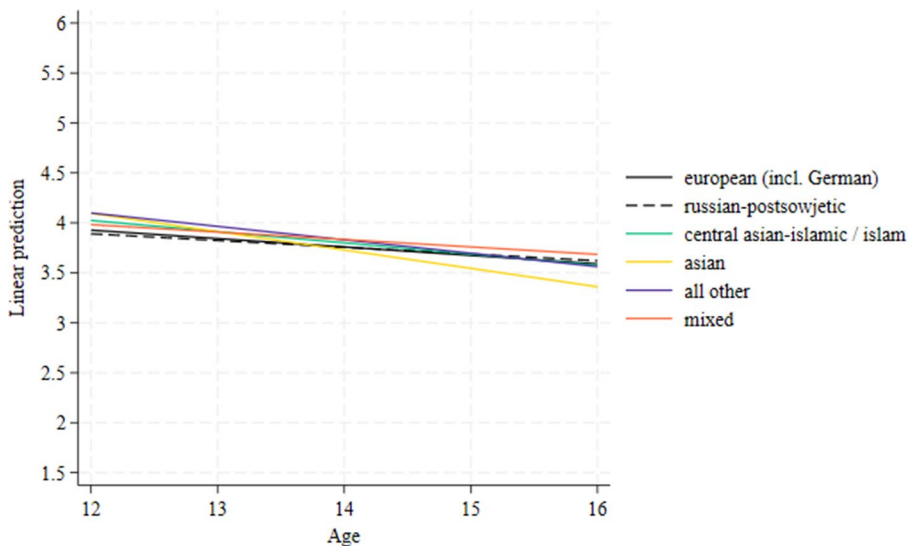


Fig. 4 Age Effects on Social Belonging by Cultural Background

Source: NEPS SC2 (<https://doi.org/10.5157/NEPS:SC2:11.0.0>); N=4,333. Note: Linear predictions based on the RE-model. Figures present predictions based on multiple imputed data in Stata (Package *mimrn*). Since confidence intervals are not correctly predicted in the marginsplot, we did not integrate them into the Figures presented. However, correct standard errors are shown in Table 2 for more detailed information

els. Similarly, adolescents with lower achievement levels appear to report marginally higher initial levels of social belonging than those with average achievement, but this difference is not statistically significant. In addition, we find no evidence of differences in the development of social belonging over time by achievement level, a pattern that holds consistently across both the random-effects and fixed-effects models. Taken together, these results do not support our theoretical arguments underlying H5, and we are therefore unable to confirm this hypothesis.

A similar degree of caution applies to age-related trends. The interaction terms with age in the random-effects models are small in magnitude and not statistically significant. In the fixed-effects model, the coefficient for adolescents from a cultural background not included in the predefined categories points in the direction of a less pronounced decline in social belonging with age; however, as this estimate is likewise not statistically significant, it should be regarded as merely suggestive rather than conclusive evidence. The differences between the random- and fixed-effects models nonetheless point to the potential relevance of time-constant confounding factors. Overall, given the large standard errors and the lack of statistical significance across specifications, we are unable to confirm our third hypothesis, and the patterns described above should be understood as descriptive tendencies rather than robust findings.

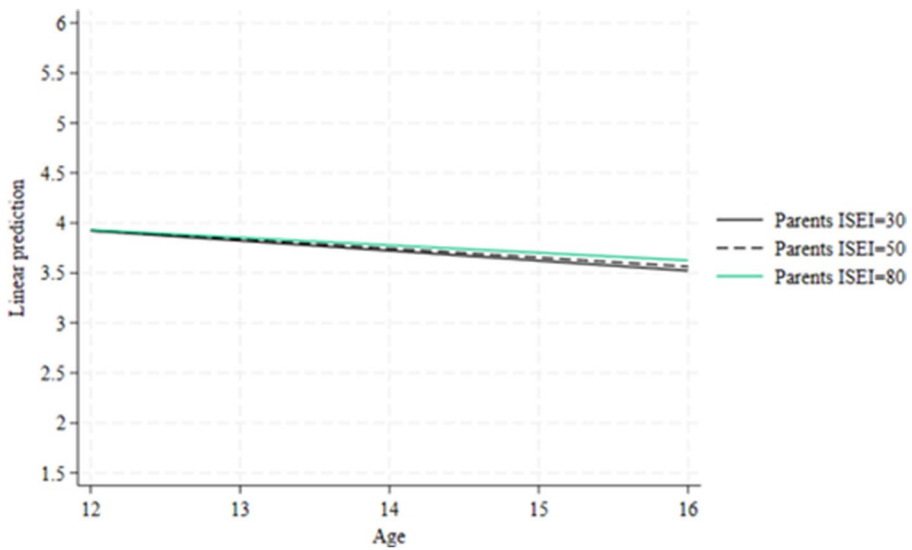


Fig. 5 Age Effects on Social Belonging by Parents' highest ISE

Source: NEPS SC2 (<https://doi.org/10.5157/NEPS:SC2:11.0.0>); N=4,333. Note: Linear predictions based on the RE-model. Figures present predictions based on multiple imputed data in Stata (Package *mimrgn*). Since confidence intervals are not correctly predicted in the marginsplot, we did not integrate them into the Figures presented. However, correct standard errors are shown in Table 2 for more detailed information

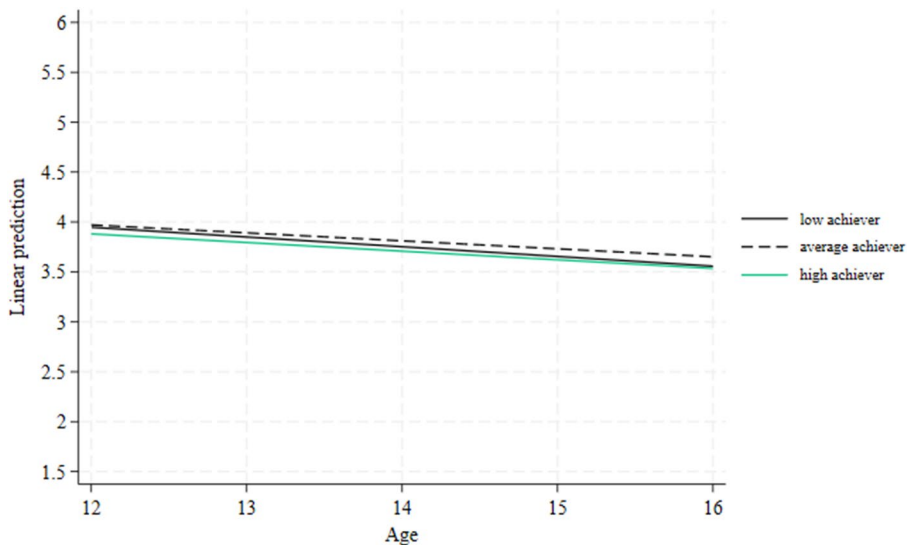


Fig. 6 Age Effects on Social Belonging by Achievement Level in Grade 4. Source: NEPS SC2 (doi.org/10.5157/NEPS:SC2:11.0.0); N= 4,333. Note: Linear predictions based on the RE-model. Figures present predictions based on multiple imputed data in Stata (Package *mimrgn*). Since confidence intervals are not correctly predicted in the marginsplot, we did not integrate them in the Figures presented. However, correct standard errors are shown in Table 2 for more detailed information

To sum up, social belonging seems to be stratified by individual characteristics, but the extent of stratification varies considerably. Gender differences are both robust and substantial: although girls start at a higher level of belonging, they experience a sharper decline with age, leading to a wide gender gap over time. In contrast, cultural background, parental socioeconomic status, and cognitive ability are associated with weaker patterns that are, in most cases, not statistically significant or not robust across model specifications and should therefore be interpreted with caution. Thus, gender emerges as the most salient and robust factor shaping both the absolute level of belonging and its age-related change, suggesting that the experience of belonging becomes particularly precarious for girls as they grow older.

6 Conclusion

This study examined the development of adolescents perceived social belonging in the domain of friendships and peer relationships, focusing on how trajectories vary by gender, cultural background, parental socioeconomic status, and cognitive ability. By addressing general peer and friendship belonging rather than school belonging, our study contributes to a broader understanding of connectedness as a crucial domain of adolescent development. By focusing on age-related developments in general as well as subgroup-specific patterns, the study offers new insights into the sense of social belonging for different subgroups. Using longitudinal data from the NEPS Starting Cohort 2, fixed-effects regression models were employed to trace how students' sense of social belonging changes as they grow older and to examine how this trajectory is shaped by individual characteristics. In addition, random-effects regression models were estimated, which provide a complementary perspective by capturing differences between student groups as well as how these groups develop over time. In contrast to the fixed-effects approach, which focuses on within-student changes over time while holding all stable individual characteristics constant, the random-effects models highlight both stable group differences and group-specific developmental patterns across age.

In line with our first hypothesis, our results demonstrate a slight decline in social belonging between the ages of 12 and 16, indicating that not only school belonging (Anderman, 2002, 2003; Ding & Hall, 2007) but also adolescents' broader sense of social connectedness undergo significant transformation during this developmental period. This pattern is especially pronounced for girls, who begin adolescence with higher levels of social belonging than boys yet show a more substantial decline over time. This finding aligns with H2, which was based on various theoretical considerations, i.e. that females and male adolescents might vary in their perception of quantity and quality of social belonging and friendships (Titzmann & Jugert, 2021). These differences may result in different ways of navigating through the challenges of forming friendships and engaging in social interactions (Newman et al., 2007). Overall, gender emerges as the most important source of inequalities in belonging during early to mid-adolescence. Recognizing the central role of peer belonging for well-being, resilience, and developmental outcomes, future research should examine the mechanisms behind these gendered patterns and identify protective factors that may

buffer against declining belonging. Such insights can guide interventions that support adolescents in navigating social challenges and building enduring connections.

By contrast, differences by cultural background, socioeconomic status, and achievement are generally weak and not statistically significant, providing little evidence that these factors drive age-related trends in peer belonging. Nonetheless, slight indications of higher initial belonging among adolescents with non-European – particularly Asian or not otherwise classified – backgrounds (Chen et al., 2011), and a gentler decline among those from more advantaged socioeconomic backgrounds (Roksa & Potter, 2011), suggest that broader social experiences outside of school also play a role (Winstone et al., 2022). Future research should therefore explore how cultural norms, family resources, and access to supportive social environments contribute to these subtle variations in belonging and identify contextual factors that strengthen peer relationships. This is especially relevant since parental influence may decrease during adolescence and the immediate peer group gains impact. Thus, including indicators of cultural minority or majority status within the peer group would be a promising avenue for understanding the mechanisms underlying the development of social belonging.

In summary, at first glance, our results may seem paradoxical, but they were theoretically expected. Positive developmental trends in competence, motivation, and access to new social opportunities would, from a normative standpoint, be expected to facilitate social belonging. Such gains should enable adolescents to navigate social contexts more effectively and to cultivate more complex and rewarding interpersonal relationships, thereby contributing to increased levels of belonging. The observed decrease, however, suggests that these developmental resources are insufficient to counterbalance the concurrent shifts in social norms and expectations regarding connectedness. Early to mid-adolescence represents a phase in which the criteria for meaningful social belonging become more demanding. As adolescents' reliance on family relationships as primary sources of belonging diminishes, they may not yet be able to establish peer relationships that provide comparable levels of stability, intimacy, and reciprocity. This misalignment can give rise to experiences of loneliness, especially for girls. Forms of social involvement previously perceived as sufficient – such as the number of friends or the frequency of social interaction – may increasingly be judged as inadequate in light of evolving social norms and personal aspirations.

Despite its valuable insights, this study also has several limitations that should be considered and addressed in future research. First, although our measure of social

belonging captures a broader understanding of adolescents' integration into peer relationships rather than being confined to the school context, it should be noted that school constitutes one of the primary settings in which adolescents form and maintain peer relationships. As a result, our data do not allow for a clean analytical distinction between peer relationships formed within versus outside the school context. Consequently, our measure of social belonging likely captures, to a considerable extent, school-related peer relationships as well as adolescents' perceptions of social ties formed in other contexts. Second, the number of adolescents from certain cultural backgrounds in our sample is relatively small. As a result, the estimated coefficients are associated with comparatively large standard errors, and some differences could not be statistically confirmed. Third, our analysis of age-related trends relies on three measurement points and on within-sample variation in age. This restricts our ability to capture more nuanced or longer-term developmental trajectories as well as trends before the age of 12. Future research would benefit from longer observation periods with more frequent measurement points to better understand how social belonging evolves across childhood and adolescence. Further, the present study focused on social inequalities by examining group differences and developmental trajectories in adolescents' social belonging. Future research could broaden this perspective by considering contextual influences that may shape individual developmental trajectories, including personal life circumstances and critical life events that alter adolescents' social environments, such as family transitions, residential moves, or changes in educational settings. In addition, incorporating a wider range of individual characteristics, such as special educational needs, personality traits, or other personal characteristics, may further improve our understanding of the development of social belonging.

Even with these limitations, the patterns we observe point to several practical implications for supporting adolescents' social development. From a policy perspective, the findings underscore the importance of addressing belonging both inside and outside of school. While schools remain central for promoting connection, it is equally crucial to create accessible social spaces beyond the educational sector that consider the diverse needs and experiences of adolescents. Supporting cultural and social activities that address gender-specific patterns of participation and promote meaningful interactions can be an important lever for strengthening adolescents' sense of belonging and improving their overall well-being and developmental opportunities.

Appendix A

Table 3 Descriptive Statistics of the Sample

	Unimputed Data					Imputed Data		
	Obs	Mean	Std. dev.	Min	Max	Obs	Mean	Std. dev. of means
Age	12,935	13.86	1.26	12	16	12,935	13.86	0.01
Female	12,935	0.52	0.49	0	1	12,935	0.52	0.00
Higher Secondary Track	10,384	0.62	0.49	0	1	12,935	0.59	0.00
Social Belonging	9,802	3.78	0.75	1	5	12,935	3.77	0.01
Cultural Background								
<i>European (incl. Germany)</i>	12,876	0.92	0.27	0	1	12,935	0.92	0.00
<i>Russian-post soviet</i>	12,876	0.03	0.17	0	1	12,935	0.03	0.00
<i>Central Asian/Islam</i>	12,876	0.02	0.14	0	1	12,935	0.02	0.00
<i>Asian</i>	12,876	0.00	0.06	0	1	12,935	0.00	0.00
<i>Other</i>	12,876	0.00	0.04	0	1	12,935	0.00	0.00
<i>Mixed</i>	12,876	0.025	0.16	0	1	12,935	0.03	0.00
Achievement Level in Grade 4	12,020	2.35	0.64	1	3	12,935	2.34	0.01
<i>Low Achiever</i>	12,020	0.09	0.29	0	1	12,935	0.09	0.00
<i>Average Achiever</i>	12,020	0.47	0.50	0	1	12,935	0.47	0.00
<i>High Achiever</i>	12,020	0.44	0.50	0	1	12,935	0.43	0.00
Parental ISEI	12,490	64.42	17.55	11.74	88.96	12,935	64.15	0.16

Source: NEPS SC2 (<https://doi.org/10.5157/NEPS:C2:10.0.0>); only individuals observed at least once in the observation period, unimputed

Table 4 Results of Factor Analysis of the Social Belonging Scale

Variable	Item	Factor 1	Factor 2	Uniqueness
Social belonging 1	I find it easy to make new friends.	0.5120	0.0767	0.7320
Social belonging 2	I often feel lonely.	-0.5481	0.2511	0.6366
Social belonging 3 ¹	I would like to have more contact to other people.	-0.2409	0.3635	0.8099
Social belonging 4	We do a lot together in my circle of friends.	0.6516	0.1431	0.5549
Social belonging 5	In my circle of friends, I find support when I have worries and problems.	0.5696	0.1626	0.6491

Source: NEPS SC2 (<https://doi.org/10.5157/NEPS:SC2:10.0.0>); N=9,835

Note: Standard errors in parentheses; ⁺ $p < 0.10$, ^{*} $p < 0.05$, ^{**} $p < 0.01$, ^{***} $p < 0.001$

Table 5 Age Effects on Social Belonging by Individual Characteristics without Imputation

	Gender		Cultural Background		Parental ISEI		Achievement Level in Grade 4	
	RE	FE	RE	FE	RE	FE	RE	FE
Age	-0.0603*** (0.0223)	-0.0693** (0.0261)	-0.0885*** (0.0174)	-0.0965*** (0.0200)	-0.0502* (0.0249)	-0.0558* (0.0283)	-0.0126 (0.0697)	-0.0339 (0.0819)
Female (ref.:male)	0.609 (0.394)							
Female x Age	-0.0380 (0.0321)	0.609 (0.394)						
Cultural Background (ref: Western-European (incl. Germany))								
<i>Russian-post soviet</i>			-1.714 (1.455)					
<i>Central-Asian/Islam</i>			-3.178 (2.175)					
<i>Asian</i>			-8.072 (8.220)					
<i>All other</i>			-0.643 (6.940)					
<i>Mixed</i>			-0.999 (2.006)					
Cultural Background x Age (ref: Western-European (incl. Germany))								
<i>Russian-post soviet</i> x Age			0.131 (0.119)	0.163 (0.145)				
<i>Central-Asian/Islam</i> x Age			0.270 (0.177)	-0.0163 (0.204)				
<i>Asian</i> x Age			0.713 (0.675)	0.721 (0.674)				
<i>All other</i> x Age			0.0337 (0.586)	-0.239 (0.656)				

Table 5 (continued)

	Gender		Cultural Background		Parental ISEI		Achievement Level in Grade 4	
	RE	FE	RE	FE	RE	FE	RE	FE
<i>Mixed x Age</i>			0.0896 (0.163)	-0.0402 (0.189)				
Parental ISEI					0.0134 (0.0124)			
Parental ISEI x Age					-0.00103 (0.00101)	-0.000884 (0.00119)		
Achievement Level in Grade 4								
<i>Low achiever</i>							1.307 (0.937)	
<i>High achiever</i>							0.472 (0.409)	
Achievement Level in Grade 4 x Age								
<i>Low achiever x Age</i>							-0.109 (0.0763)	-0.181* (0.0894)
<i>High achiever x Age</i>							-0.0492 (0.0333)	-0.0556 (0.0384)
_cons	4.371*** (0.292)	5.075*** (0.229)	4.778*** (0.235)	5.084*** (0.241)	4.395*** (0.316)	5.105*** (0.229)	3.916*** (0.863)	5.089*** (0.229)
Controls	YES	YES	YES	YES	YES	YES	YES	YES
N	2232	2232	2232	2232	2232	2232	2232	2232
Observations	5942	5942	5942	5942	5942	5942	5942	5942

Source: NEPS SC2 (<https://doi.org/10.5157/NEPS:SC2:10.0.0.0>); N=9,835Note: Standard errors in parentheses; † $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Appendix B

Table 6 Results of Structural Equation Modelling for the Social Belonging Scale

Measurement	2018/2019		2020/2021		2021/2022	
	Factor Loadings					
	Coefficient	P-Value	Coefficient	P-Value	Coefficient	P-Value
Social Belonging 1	1.074	0.000	1	constrained	1	con- strained
	(0.007)					
Social Belonging 2 (reversed)	1	constrained	0.902	0.000	0.902	0.000
			(0.006)		(0.006)	
Social Belonging 4	1.097	0.000	1.097	0.000	1.097	0.000
	(0.032)		(0.032)		(0.032)	
Social Belonging 5	0.847	0.000	0.847	0.000	0.847	0.000
	(0.029)		(0.029)		(0.029)	
Mean	3.546	0.000	3.506	0.000	3.371	0.000
	(0.021)		(0.016)		(0.019)	
Residual Variances						
Social Belonging 1	0.585		0.747		0.867	
	(0.019)		(0.023)		(0.030)	
Social Belonging 2 (reversed)	0.554		0.821		0.843	
	(0.017)		(0.023)		(0.027)	
Social Belonging 4	0.632		0.764		0.767	
	(0.021)		(0.027)		(0.032)	
Social Belonging 5	0.791		0.822		0.821	
	(0.023)		(0.024)		(0.029)	
F1	0.307		0.338		0.437	
	(0.014)		(0.016)		(0.022)	
Residual Covariances						
Social Belonging 4* Social Belong- ing 5	0.209	0.000	0.238	0.000	1.867	0.000
	(0.017)		(0.020)		(0.024)	

Source: NEPS SC2 (<https://doi.org/10.5157/NEPS:SC2:10.0.0>); $N=9,873$

Note: Standard errors in parentheses; $^+p < 0.10$, $^*p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$

Table 7 Fit statistics for

Fit Statistics	Value
Likelihood Ratio	
Chi ²	147.624
p > Chi ²	0
Population Error	
RMSEA	0.054
90% CI, lower bound	0.046
upper bound	0.062
Information Criteria	
AIC	108889.875
BIC	109091.362
Baseline Comparison	
CFI	0.978
TLI	0.972
Size of Residuals	
SRMR	0.022
CD	0.623

Source: NEPS SC2 (<https://doi.org/10.5157/NEPS:SC2:10.0.0>);
N=9,873

Note: Standard errors in parentheses; [†]p < 0.10, *p < 0.05, **p < 0.01, ***p < 0.001

Table 8 Age Effects on Social Belonging by Individual Characteristics using Social Belonging Factor Score (Imputed Sample)

	Gender		Cultural Background		Parental ISEI		Achievement Level in Grade 4	
	RE	FE	RE	FE	RE	FE	RE	FE
Age	-0.0772*** (0.00632)	-0.109*** (0.00946)	-0.0925*** (0.00590)	-0.117*** (0.00717)	-0.0905*** (0.00636)	-0.116*** (0.00982)	-0.103*** (0.0107)	-0.101*** (0.0253)
Female (ref: male)	0.386*** (0.0682)							
Female x Age	-0.0302*** (0.00491)	-0.0122 (0.0137)						
Cultural Background (ref: European (incl. Germany))								
<i>Russian-post soviet</i>			-0.286 (0.231)					
<i>Central-Asian/Islam</i>			0.352 (0.244)					
<i>Asian</i>			0.518 (0.385)					
<i>All other</i>			0.261 (0.948)					
<i>Mixed</i>			0.0677 (0.201)					
Cultural Background x Age (ref: European (incl. Germany))								
<i>Russian/post-Soviet x Age</i>			0.0195 (0.0161)	0.0179 (0.0421)				
<i>Central-Asian/Islam x Age</i>			-0.0247 (0.0175)	-0.0354 (0.0418)				
<i>Asian x Age</i>			-0.0382 (0.0296)	0.135 (0.126)				
<i>All other x Age</i>			-0.0186 (0.0692)	0.148 (0.168)				

Table 8 (continued)

	Gender		Cultural Background		Parental ISEI		Achievement Level in Grade 4	
	RE	FE	RE	FE	RE	FE	RE	FE
<i>Mixed x Age</i>			−0.00129 (0.0142)	0.0481 (0.0422)				
Parental ISEI					−0.00191 (0.00204)			
Parental ISEI x Age					0.000168 (0.000145)	−0.000219 (0.000382)		
Achievement level in grade 4 (ref: average achiever in grade 4)								
<i>Low Achiever</i>							0.112 (0.136)	
<i>High Achiever</i>							−0.0146 (0.0734)	
Achievement Level in Grade 4 x Age								
<i>Low Achiever x Age</i>							−0.00996 (0.00968)	−0.0103 (0.0264)
<i>High Achiever x Age</i>							−0.00996 (0.00968)	−0.0103 (0.0264)
_cons	4.407*** (0.0863)	4.964*** (0.0841)	4.620*** (0.0802)	4.964*** (0.0843)	4.620*** (0.0862)	4.967*** (0.0840)	4.768*** (0.148)	4.963*** (0.0842)
Controls	YES	YES	YES	YES	YES	YES	YES	YES
N	4333	4333	4333	4333	4333	4333	4333	4333
Observations	12,935	12,935	12,935	12,935	12,935	12,935	12,935	12,935

Source: NEPS SC2 (<https://doi.org/10.5157/NEPS:SC2:10.0.0>); N = 4,333Note: Standard errors in parentheses; $^{\dagger} p < 0.10$, $^* p < 0.05$, $^{**} p < 0.01$, $^{***} p < 0.001$

Appendix C

Table 9 Age Effects on Social Belonging by Individual Characteristics – Nonlinear Age Effects (Fixed-Effects Regression)

	Social belonging
Age-Dummies (Ref.: Age 12)	
13	-0.108*** (0.0289)
14	-0.325*** (0.117)
15	-0.429*** (0.118)
16	-0.480*** (0.130)
_cons	3.965*** (0.0117)
Observations	12,935
N	4,333

Source: NEPS SC2 (<https://doi.org/10.5157/NEPS:SC2:10.0.0>); N=4,333

Note: Standard errors in parentheses; $^+p < 0.10$, $^*p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$

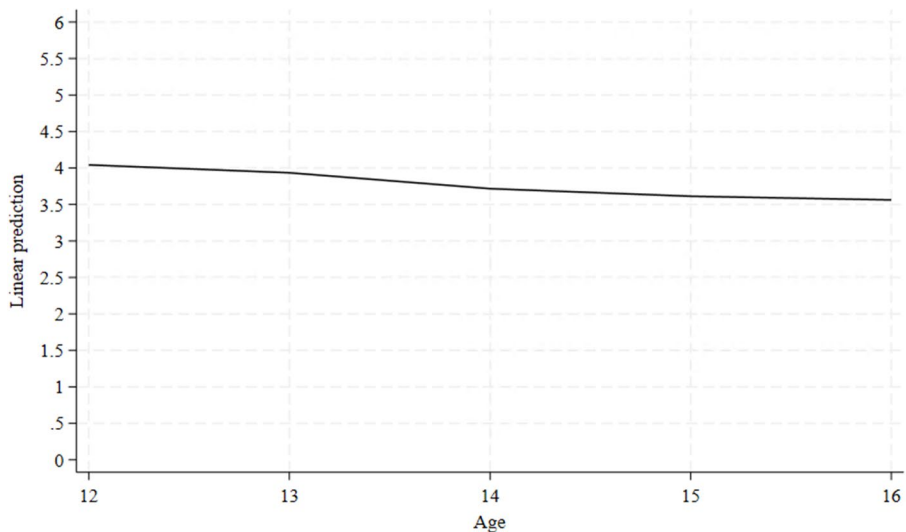


Fig. 7 Age Effects on Social Belonging by Individual Characteristics – Nonlinear Age Effects (Fixed-Effects Regression)

Source: NEPS SC2 (<https://doi.org/10.5157/NEPS:SC2:11.0.0>); N=4,333. Note: Linear predictions based on the FE-model. Figures present predictions based on multiple imputed data in Stata (Package mimrgn). Since confidence intervals are not correctly predicted in the marginsplot, we did not integrate them into the Figures presented. However, correct standard errors are shown in Table C1 for more detailed information

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Declarations

Competing interest The authors declare no competing interests.

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