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Be With Me: Well-Being and Sibling Contact;

the Moderating Role of Autistic Traits

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A thesis submitted to the faculty of
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Master of Science

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ABSTRACT

Be With Me: Well-Being and Sibling Contact;
the Moderating Role of Autistic Traits

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Master of Science

Sibling contact (synchronous or asynchronous) in young adulthood may have implications for individual well-being (health, life satisfaction & depressive symptoms). This link may be moderated by each individuals' traits, specifically autistic characteristics. Current literature has examined sibling contact, mediums of contact, autism relationships, but has yet to consider sibling contact moderated by autistic traits. This study analyzed data from 390 young adults 61% female, mean age = 25.65) who gave self-reports over two collection waves. Structural Equation Models found that regardless of autistic traits, synchronous contact was linked with increased life satisfaction as well as lower depressive symptoms, and asynchronous contact was linked with increased life satisfaction. Interactions between each type of contact and autistic traits found that for those lower in autistic traits, increases in each type of contact was linked with greater life satisfaction, and higher levels of asynchronous contact was linked with lower depressive symptoms, for those with lower levels of autistic traits. Autistic traits do moderate the process of siblings communicating and create a neutral space for those who are higher in traits. Young adults should prioritize sibling contact to improve their life satisfaction and depressive symptoms, and clinicians should encourage sibling contact in young adulthood.

Keywords: siblings, autism, autistic traits, well-being, contact, life satisfaction, depressive symptoms, young adulthood

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Sibling contact has a unique link to well-being, especially in young adulthood (Bedford & Avioli, 2012; Cicirelli, 1989; McCamish-Svensson et al., 1999; Sherman et al., 2006). The different types of contact available can change how siblings feel about their interactions; some forms of contact are more synchronous and instantaneous, while other forms of contact are more asynchronous and take time between responses from each person. The influence of contact on well-being may be moderated by each person's strengths and limitations, particularly traits linked to autism spectrum disorder. Each person's specific characteristics may change how each type of contact changes their well-being. This thesis sought to illuminate the nuances of sibling contact through various methods, specifically for those who exhibit a higher level of autistic traits. It expands on the literature on sibling contact and introduces the element of autistic traits within the sibling contact relationship.

The Bioecological Model

The bioecological model (Bronfenbrenner, 1979) focuses on the influence of multiple systems on development, as well as interrelated-ness among different systems levels. It includes the individual as the center of the model, followed by the microsystem, which includes contexts the individual has direct contact with (e.g., their spouse and their parents). The next system is the mesosystem, which consists of links between two or more microsystems. For example, their connection between their spouse and their family of origin. The exosystem is next; this is made up of systems and institutions not experienced directly by the individual, but which still impact development (e.g., spouse's workplace, or their parents' neighborhood). The macrosystem

includes the broader cultural context of the individual. Finally, the chronosystem focuses on time and the unique historical context in which individuals develop.

The bioecological model also includes some lesser known, but still vital aspects, specifically, the concepts of Process-Person-Context-Time (PPCT). Process refers to direct reciprocal interactions with the environment and people. Person refers to the personal characteristics each person inherently possesses. Context is the environment in which they are currently in including the micro, meso, exo, and macro systems. Time refers to the duration of processes, current events, or significant transitions (Bronfenbrenner, 1995). One of the main appeals of the PPCT model is its acknowledgement of the synergistic influences of each of those four pieces in analyzing human development.

The PPCT aspects of the bioecological model help explain the relational process of sibling contact by placing each part of this process in a synergistic exchange, where one part impacts the others and vice versa. Although Bronfenbrenner never explicitly talked about siblings, his descriptions of "significant others" (1995) matches well with young adult sibling relationships; they are a constant part of their context, have been for years and will most likely continue to remain as such.

Sibling Contact and Well-Being

In this thesis, I considered sibling contact to be a proximal process from the PPCT. Although siblings spend much of their childhood together, the milestones accompanying young adulthood, such as moving away to college, getting married, or starting a career, may naturally make it more difficult for siblings to stay in contact (Conger & Little, 2010). Sibling contact may not come as naturally during this time of transition, and therefore changes the relationship from a

convenient co-residing one, to one that requires purposeful effort in order to be maintained. The two more prominent reasons to stay in contact are that siblings feel obligated to have a relationship with their kin, or that they enjoy each other's company and willingly seek each other out (Lee et al., 1990). Although contact may lessen during young adulthood (White, 2001), research has shown that the sibling relationship during that period tends to have less conflict than in adolescence, and the same amount of closeness (Jensen et al., 2018 & Whiteman et al., 2011). Perhaps siblings continue to feel close to each other even without constant contact because of the sense of security that comes from a lifelong relationship (Bank, 1995). When siblings do have contact it can serve as an important process in young adulthood because siblings are a significant person that has been present for their entire lives and they have a great deal of influence on one another.

According to the PPCT aspects of the bioecological model, proximal processes are meant to foster competence or inhibit dysfunction (Bronfenbrenner, 1995). In this way, sibling contact may serve to promote well-being for young adults. Well-being markers vary greatly in the literature (Bedford & Avioli, 2012; Cicirelli, 1989; Sherman et al., 2006) and this study focused on life satisfaction, depressive symptoms, and health. Humans greatly benefit from social interactions, and past research has shown that social contact is linked with well-being (Shor & Roelfs, 2015). Social relationships may even be linked to survival; a meta-analysis led by Holt-Lunstad found that those with good social relationships had a 50% higher survival rate than those without such relationships (Holt-Lunstad et al., 2010). Siblings who are in contact with each other tend to report greater well-being (Bedford & Avioli, 2012; McCamish-Svensson et al., 1999; Sherman et al., 2006). Siblings who report a good bond with their sister also show

fewer symptoms of depression in later life (Cicirelli, 1989). Research has shown that in older

adults, those who give support to their siblings report less loneliness and therefore have greater

life satisfaction (Bedford & Avioli, 2012). This may be indicative of the sense of security that

comes from knowing that a sibling will be there no matter what happens in life. In his meta-

analysis Stephen P. Bank (1995) referred to this as the "reservoir of help," meaning that the

potential availability of sibling support is more predictive of well-being than the support itself.

Types of Contact

The C in the PPCT stands for the context in which a proximal process occurs

(Bronfenbrenner, 1995). In this thesis, I considered the way siblings have contact to be the

context for the contact itself. Thus, I divided sibling contact into two types: asynchronous

contact (texting, social media, or email) and synchronous contact (face-to-face or over the

phone). The context in which this proximal process is taking place is either through synchronous

or asynchronous contact, since the type of contact may change the communication itself.

Since the arrival of the internet and then the widespread use of cellphones,

communication has drastically changed in the last 30 years (Eapen et al., 2010). Before these

inventions, conversations largely happened in person, or over the phone. Today communication

includes various new methods, such as texting, direct messaging, poking, and snapchatting, and

these can be accessed anywhere and anytime with small handheld devices. According to the Pew

Research Center, 97% of Americans have a smartphone, 93% of adults use the internet, and 72%

use social media (2021a; 2021b; 2021c). Additionally, 100% of adults between the ages of 18-49

own a cellphone and 95-96% of those are smartphones (Pew Research Center, 2021). These

numbers emphasize that the way communication happens now is vastly different than how it was

in the past. Thus, young adults today have completely different experiences communicating than the generations before them (Hynan et al., 2014; Morey et al., 2013; Ramsey et al., 2013) who were more likely to solely use synchronous methods of contact.

Synchronous Means of Contact

For this thesis, synchronous contact refers to phone calls and in-person visits. This type of contact does not only use words, but also includes tone of voice during phone calls, and tone of voice as well as body language during in-person visits. Synchronous contact is contact that does not have delays or pauses during conversations caused by reading time. For middle-aged and older adult siblings, in person contact as well as telephone calls have been linked to higher levels of closeness (Hill et al., 2020). During young adulthood, siblings report successfully maintaining their relationships by communicating via telephone as well as in-person visits, which leads to more frequent self-disclosure, thus fostering intimacy in the relationship (Lindell et al., 2015). Relationships are strengthened by synchronous means of contact (Jin & Peña, 2010; Milevsky, 2019; Nilsson & Mattes, 2015); however, individuals who struggle with in-person interactions were also likely to report fewer phone calls in their romantic relationship than those who are at ease with in-person interactions (Jin & Peña, 2010). Although synchronous contact typically has more positive results, the outcomes are heavily influenced by each individual's traits and preferences.

Asynchronous Means of Contact

Asynchronous contact within relationships has been widely studied. In this study, I used the term asynchronous contact to encompass texting, social media, and email, since all of these forms of contact require pauses in the conversation as each person reads, formulates a response,

and then responds. Communication in these ways may occur over a longer span of time than when interacting synchronously. One of the differences between asynchronous and synchronous contact is that during asynchronous contact you cannot hear the voice of the other, and therefore have to assume the tone. Because you cannot rely on regular social cues of tone of voice or body language; the tone of the conversation is subjective to the receiver. Since sibling lives have such a vast shared history, it may be easier (and therefore less stressful) to accurately assume the correct tone when communicating with a sibling through asynchronous means, than any other relationship.

Research shows varying and conflicting results as outcomes of asynchronous contact. Some studies show that asynchronous contact can be very beneficial and lead to greater wellbeing (Choi & Noh, 2020; LaRose et al., 2001; Uusiautti & Määttä, 2014) as well as better relationships (Crosswhite et al., 2014; Johnson et al., 2008; Ohadi et al., 2018; Stafford et al., 1999), specifically for siblings (Hill et al., 2020). Research has even found that asynchronous means of contact are particularly beneficial to individuals who struggle with in-person social ties and intimacy (Ellison et al., 2007; Reid & Reid, 2010; Seabrook et al., 2016) because it fulfills their psychological needs for connection, thus improving their wellbeing (Park & Lee, 2012). However, other studies have found that asynchronous contact has a negative influence on young adults (Cain, 2018; Hanna et al., 2017) and can be linked to depression and anxiety (Bettmann et al., 2021; Primack et al., 2017; Seabrook et al., 2016). These negative concerns may be particularly potent for those who already struggle with in-person connections (Kraut et al., 2002; Seabrook et al., 2016), and they may even avoid it altogether (Drouin & Landgraff, 2012).

Although the research is conflicting, the outcomes of asynchronous contact are unique and worth exploring.

The Role of Autistic Traits

The second P in the PPCT stands for person, specifically the biopsychological characteristics of the individual person (Bronfenbrenner, 1995). The bioecological model suggests that these personal characteristics moderate the role of proximal processes. In this thesis I proposed that autistic traits are an integral personal characteristic that may change how synchronous and asynchronous contact are linked to well-being.

The autism spectrum encompasses a wide range of symptom severity, with each individual presenting unique strengths and challenges (Autism Speaks, n.d.). In the United States, 1 in 54 children have an Autism diagnosis (CDC, 2020), and this disorder is characterized by deficits in social communication and interaction, as well as restricted, repetitive behaviors (American Psychiatric Association, 2013). The Autism spectrum includes a wide array of expressions, and this extends even wider to non-diagnosed phenotypic characteristics of Autism.

Researchers have utilized autistic traits without an official autism diagnosis to study and make inferences for the autism community, specifically within romantic relationships (Jobe & White, 2007; Lamport & Turner, 2014), sibling relationships (Jensen & Orsmond, 2019; Petalas et al., 2012), and in friendships (Wainer et al., 2013). My study utilized autistic traits to capture a greater sample size that still encompasses the major characteristics seen in autism. Researchers theorize that the full range of ASD traits may be present in some of the general population but they are milder and much more subtle (Baker, 2004; Rankin & Tomeny, 2019). The Autistic Self Advocacy Networks (ASAN) disagrees that an official autism diagnosis is required in order to

identify as autistic, since this places clinicians as gatekeepers to the autistic community (ASAN, n.d.; Whitlock et al., 2020; Unigwe et al., 2017). The ASAN would argue that if you feel autistic, then you are (ASAN, n.d.). This is especially true for females since they are diagnosed at a much lower rate than males because they do not display "typical" autistic traits during clinical evaluations and are often not given the correct diagnosis (Beck et al., 2020). Whether an individual presents clinical or sub-clinical levels of Autism, the traits in and of themselves are the same. Therefore, we can use a sub-clinical sample to understand the influence of the traits of Autism on relationships.

Social Contact and Autistic Traits

An important part of the PPCT model is the concept of synergy (Siraj & Huang, 2020; Xia et al., 2020) and how it fits within each part of this model. I offer that each individual's level of autistic characteristics may change the preferred means of contact, therefore changing the experience of the proximal process itself. I also propose that the type of contact between siblings may influence the quality of that contact, and this in turn affects each person differently, depending on their autistic traits.

Those who display high levels of autistic features are likely to have greater difficulty experiencing social interactions and friendships. Jobe & White (2007) found that those with high levels of autistic characteristics were more likely to experience fewer and shorter friendships. Research also shows that individuals with higher levels of autistic traits experienced less satisfaction from friendships and felt more social isolation and loneliness within those friendships (Wainer et al., 2013). Although individuals with high levels of autistic traits may be able to develop strong friendships, they may not be receiving the same benefits as those with

lower levels of traits due to the unique challenges they face within social interactions. Those with more autistic features struggle with relationships more because some of the key impairments are social-emotional reciprocity as well as understanding, developing and maintaining social relationships (American Psychiatric Association, 2013). Therefore, those traits that make it more difficult for them to connect socially, may make friendships and social interactions much less fulfilling than for those with fewer autistic characteristics.

Within romantic relationships, research has shown that individuals with high levels of autistic traits tend to feel more loneliness even while they are in a romantic relationship, even if they maintain them for long periods of time (Jobe & White, 2007). Research also shows that individuals with high levels of autistic traits also report lower levels of empathy and thus have less secure romantic attachments (Lamport & Turner, 2014). Further, research has shown that men with more autistic traits feel that they cannot trust their partner in a romantic relationship, struggle with responsiveness, and thus show lower relationship satisfaction (Pollman et al., 2010). Therefore, romantic relationships, although attainable, may not bring the desired effects of companionship for individuals with high levels of autistic traits in the same way that they do for individuals with lower levels of autistic traits. Their unique phenotypic characteristics may make it more difficult for them to feel social connectedness.

A high level of autistic traits likely makes sibling contact less fulfilling. When one sibling has more autistic characteristics, the relationship tends to be more challenging (Orsmond et al., 2009; Shivers et al., 2019; Tozer & Atkin, 2015); however, research has also shown that relationships tend to have more support when one sibling has high levels of autistic traits (Jensen & Orsmond, 2019), and that the relationship improves with age: young adults have better

relationships with their sibling with an Autism Spectrum Disorder than do young adolescents (Laghi et al., 2018). Yet research has shown that in a relationship with a sibling with an ASD, there is greater variability of sibling relationships within the same families than between different families (Orsmond & Fulford, 2018). We can expect the same pattern in sibling relationships as in friendships and romantic relationships. Because those with more autistic traits may struggle with interpreting body language and other social cues (Philip et al., 2010), asynchronous contact like texting, may allow them to focus on what their sibling is saying, rather than having to decipher their body language. Since the proximal process of sibling communication has been in place since the early years of each individual, they may have an advantage over other relationships due to the amount of time they have been connected. This allows time (the last piece of the PPCT model), to play an important role in the perception of sibling relationships.

Current Study

This study evaluated how autistic traits moderated the relationships between communication with a sibling and well-being for young adults. The sibling relationship changes in young adulthood (Conger & Little, 2010; Lee et al., 1990), but since their lives are inherently linked from proximal processes that have occurred over long periods time, as well as their person being similar due to genetic makeup (Bronfenbrenner, 1995), their connection is likely to remain close (Jensen et al., 2018; Whiteman et al., 2011). This close connection is important since siblings who report greater contact also report greater well-being (Bedford & Avioli 2012; Cicirelli, 1989). Individuals who display higher levels of autistic traits often do not receive the same benefits from relationships, as seen in past research with friendships and romantic

relationships (Howlin et al., 2015; Jobe & White, 2007; Lamport & Turner, 2014; Wainer et al., 2013). Sibling relationships may bring their unique set of challenges for those with high levels of autistic traits. However, different types of contact may be more beneficial for those with more autistic features. Asynchronous contact removes the obstacles of body language and tonality (that come with in-person or synchronous contact) which may be particularly difficult for those with more autistic traits. Asynchronous contact has been shown to be more beneficial for those who struggle with in-person social interactions (Ellison et al., 2007; Reid & Reid, 2010; Seabrook et al., 2016). In addition, the shared proximal process of sibling communication that has been in place since childhood may be unique and create a relationship in young adulthood that is easier to maintain than friendships or romantic relationships, especially due to the length of time they have been communicating and their ease in understanding each other because of their shared traits. It may be particularly beneficial for individuals with high levels of autistic traits to interact with a sibling, specifically through technological means.

Based upon trends in the literature, this study investigated the following hypotheses:

H1 - Sibling contact (asynchronous and synchronous) would be positively associated with changes in well-being.

H2 - The link between sibling contact and well-being would be moderated by autistic traits such that those with more autistic traits would benefit less from sibling contact – particularly for synchronous contact.

H3 - Asynchronous contact would be more beneficial than synchronous contact for those with high levels of autistic traits.

Figure 1 in Appendix B shows my theoretical model, including predictors from time 1. My

model also included several control variables that are listed in the method section; however,

those were not included in the graphic for parsimony.

Method

For this study, I used longitudinal data to analyze a group of young adults ages 18 to 29.

In this section, I present the data collection that was used, as well as some demographic

information. I also discuss the participants and measurements used in this sample.

Participants

The data for this research came from the first two waves of the Sibling Influence on

Becoming Adults Study (SIBS; Jensen, 2017). The overall study had 1750 participants and was

50% male (n = 875) and 50% female (n = 875). A supplemental survey was sent out after Time 1

and only 866 of the original sample responded, the participants were 55.5% female (n=480), with

a mean age of 25.42. When the full survey was sent out again for Time 2, the number of

participants dropped to 736 young adults, however due to planned missingness, the final sample

used in my analyses had 390 participants. The final sample was 60% female, and the average age

was 25.65. All the demographic information for this sample are available in Table 1.

Procedures

Participants were collected through self-reports using Amazon Mechanical Turk

(MTurk). MTurk is a crowdsourcing outlet for virtual tasks, such as survey responses.

Participants had to live in the United States and had to have completed over 500 tasks and a 95%

approval rating on MTurk to be eligible to participate in the survey. They first consented to

participate and then rated their well-being, depressive symptoms, and contact with their closest-

aged sibling, among many other measures in wave one of the study. They were given an honorarium of $2.25. After completing the main survey, participants were given the option to take a supplemental survey that included items assessing autistic traits. The honorarium for this supplemental survey was $3. Then the wave two survey was conducted one year following wave one. The honorarium for wave two was $4.

In total, wave one included 1750 participants. Of those 1750, only 866 took the wave one supplemental survey. Of the 1750 who took the wave one survey, 736 took the wave two survey. Because autistic traits were assessed in the wave one supplemental survey, however, only those who completed the supplemental survey from wave one and the wave two survey could be included in the final sample. Thus, my final analytic sample included 390 participants. Admittedly, retention overall was poor since MTurk does not allow researchers to contact participants directly; rather, retention is largely dependent on participants still being active MTurk users. All of the procedures were approved by the Institutional Review Board of BYU.

Measures

Well-being

The well-being of participants was measured using three different measures within the dataset: health, life satisfaction and depressive symptoms.

Health. The health measure used one question "In the past year, how has your health been in general?" Participants answered using a Likert scale of 1-5 with one being Poor and five being Excellent. This served as a general marker for the participants' overall health throughout their lives. Research has shown that a one item self-perceived health question was only surpassed

in reliability by a high blood pressure indicator (Lundberg & Manderbacka, 1996) and therefore considered reliable for my study.

Life Satisfaction. The scale for life satisfaction came from the highly validated scale by Diener et al. (1985), with test-retest reliability=.82 and Cronbach's alpha=.94. This scale used five statements rated on a 1-7 Likert scale with one being Strongly disagree and seven being Strongly agree. One of the statements was "In most ways my life is close to ideal," while another was "I am satisfied with my life."

Depressive Symptoms. Depressive symptoms were assessed with seven items from the Depression Anxiety Stress Scales (DASS; Lovibond & Lovibond, 1995) which has a test-rest of .99 and Cronbach's alpha of .95. Participants were asked to answer the following question "How much does the statement apply to you OVER THE PAST WEEK" for seven statements using a Likert scale of 1-4 with one being "Did not apply to me at all" and four being "Applied to me very much, or most of the time." One of the statements was "I felt that I had nothing to look forward to" and another was "I felt that life was meaningless."

Contact

The Contact measure for this study was based on the Blyth et al. (1982) Intimacy Questionnaire, which asked young adults how frequently they saw significant people in their lives (including siblings) in a variety of settings. Although text, email, and social media were not available in 1982, the model remains the same, just through different mediums of contact. I used their 7-question contact scale to measure the frequency and type of contact participants had with their sibling and revised it to add text, email, and social media. Each of the statements was measured on a 0-8 Likert scale with zero meaning Never and eight meaning Daily. There were two sub-

categories within this scale, one for synchronous contact (in person or phone) and the other for asynchronous (text, email, social media). The synchronous contact portion included the following two statements: "In the past 12 months, how often have you seen your sibling in person?" and "In the past 12 months, how often have you had contact with your sibling by telephone?". I added the number of each types of synchronous contact to get a total number representing all the synchronous contact between each sibling pair. The asynchronous contact portion used the following three statements "In the past 12 months, how often have you had contact with your sibling via social media - i.e., Facebook, Twitter, Instagram?", "In the past 12 months, how often have you had contact with your sibling via instant or text messaging?" and "In the past 12 months, how often have you had contact with your sibling via email?". I also added the number of each statement to create a total representing the amount of asynchronous contact between the sibling pairs. Additionally, it is important to note that through further analysis, I found that over 50% of the sample had never utilized email as a form of contact. This may make it difficult to interpret the results, but I decided to keep the measure in the study since my original research question included email communication between siblings.

Autistic Traits

To measure autistic traits we used the 50-question Autism Quotient designed by Baron-Cohen and colleagues (2001). I used the Autism Quotient (AQ) in order to capture all spectrums of autistic traits, even without an official diagnosis. The AQ was designed to assess how much adults display traits associated with the autism spectrum in five areas: social skills, attention switching, attention to detail, communication, and imagination. Each item was scored as zero or one, and then summed together. Higher values reflected more autistic characteristics, not a

specific diagnosis. Other data suggest that mean Autism Quotient scores in a non-clinical sample should be around 16.94, whereas those with a diagnosed ASD typically have mean scores of 35.19 (Ruzich et al., 2015). Cronbach's alpha for this scale was .82.

Control Variables

The breakdown of each control variable is in Table 1 in Appendix A. This study included control variables on the individual and sibling level. I included each participants' age, gender, education levels, and marital status. Gender was coded as female = 0 and male = 1. Education level was used to account for socioeconomic status, it was coded as 1 = no education, 2 = elementary school, 3 = some high school, 4 = high school, 5 = vocational school/trade, 6 = college graduate, 7 = post college, and 8 = other. Participant marital status was coded as 0 = not married and 1 = married. Ethnicity was entered in as 0 = Caucasian and 1 = minority. I also used the number of siblings in the family, the biological relatedness of siblings and their birth order. The number of siblings in the family was coded as 0 = one sibling and 1 = two or more siblings, in order to control for family size. Sibling biological relatedness was included to control for the relationship type between siblings. This was coded as 1 = fully biological siblings, 2 = half siblings, 3 = adoptive, and 4 = stepsiblings. Birth order was used as a control to ensure that the results were not being confounded by the changing sibling relationships depending on birth order, this was coded as either 0 = participant older than their sibling or 1 = participant was younger than or equal in age to their sibling. I also controlled for the sex composition of the siblings since this can change sibling dynamics. This was coded as 0 = same sex siblings and 1 = different sex siblings.

Results

Analytic Strategy

In order to determine how different types of sibling contact (synchronous vs asynchronous) are associated with young adult well-being (life satisfaction, depressive symptoms, and health), I estimated a longitudinal structural equation model. I used Mplus version 8.5 (Muthén & Muthén, 1998-2020) to estimate my structural equation models. I used Full Information Maximum Likelihood (FIML) to estimate the missing data between waves one and wave two.

I used a series of models to test the how contact is linked to changes in well-being. A separate series of models was tested for synchronous and asynchronous contact. For each series of models life satisfaction, depressive symptoms, and health were tested simultaneously as outcomes. In the first model, I regressed contact (either synchronous or asynchronous), autistic traits, and the corresponding out coming variable from Time 1 on life satisfaction, depressive symptoms, and health from Time 2. In the second model, I added the following control variables: each participants' age, gender, ethnicity, education levels, and marital status, number of siblings in the family, biological relatedness of siblings, birth order and sex composition of each sibling pair. In the third model, I added the interaction of contact (either synchronous or asynchronous) and autistic traits to the model. All continuous predictors were mean centered and in the third model I checked the effect for high and low autistic traits.

Descriptive Statistics

I first looked at general descriptive statistics for the sample. Table 1 gives the demographic statistics and Table 2 gives bivariate correlations of all the dependent and

independent variables used in the models. Although all the correlations were small, they were

significant in the expected directions.

Synchronous Contact

Although the three well-being measures were tested simultaneously in the same model,

results are presented in separate tables to promote clarity.

Results for life satisfaction are found in Table 3. Model 1 showed adequate fit ($\chi^2(154) =$

364.74, $p < .001$ CFI = .95, TLI = .94). In Model 1, life satisfaction from Time 1 ($b = .68, p <$

.001) and synchronous contact ($b = .08, p < .05$) were linked to increases in life satisfaction.

Model 2 also showed adequate fit ($\chi^2(286) = 500.92, p < .001$, CFI = .95, TLI = .94). In Model

2, after the inclusion of control variables, life satisfaction from Time 1 ($b = .67, p < .001$) and

synchronous contact ($b = .09, p < .05$) were still linked to increases in life satisfaction. Model 3

showed adequate fit ($\chi^2(286) = 504.55, p < .001$, CFI = .95, TLI = .94). In Model 3, the

interaction between synchronous contact and autistic traits was significant ($b = .08, p < .05$).

Simple slopes showed that for those higher in autistic traits there was no link between

synchronous contact and life satisfaction ($b = .02, p = .69$). For those lower in autistic traits,

synchronous contact was linked to increases in life satisfaction ($b = .16, p < .001$).

Findings for depressive symptoms are found in Table 4. Model 1 showed adequate fit

($\chi^2(154) = 364.74, p < .001$ CFI = .95, TLI = .94). In Model 1, life satisfaction from Time 1 ($b =$

.61, $p < .001$) and synchronous contact ($b = -.10, p < .05$), were linked to fewer depressive

symptoms. Model 2 showed adequate fit ($\chi^2(286) = 500.92, p < .001$, CFI = .95, TLI = .94). In

Model 2, once control variables were added to the model, the effects of depressive symptoms

from Time 1 ($b = .61, p < .001$) and synchronous contact ($b = .11, p < .01$) remained, and

number of siblings ($b = .29$, $p < .01$), and sibling relationship type ($b = -.27$, $p < .01$) were linked to depressive symptoms. Model 3 showed adequate fit ($\chi^2(286) = 504.55$, $p < .001$, CFI = .95, TLI = .94). In Model 3 the interaction was not significant, therefore no tests of simple slopes was performed.

Results for health are found in Table 5. Only health from Time 1 was linked to health across all models. Model 1 showed adequate fit ($\chi^2(154) = 364.74$, $p < .001$ CFI = .95, TLI = .94). Model 1 linked health from Time 1 ($b = .67$, $p < .001$). Model 2 also showed adequate fit ($\chi^2(286) = 500.92$, $p < .001$, CFI = .95, TLI = .94) and with control variables added, health from Time 1 was linked again ($b = .66$, $p < .001$). Model 3 showed adequate fit ($\chi^2(286) = 504.55$, $p < .001$, CFI = .95, TLI = .94). The interaction in Model 3 was not significant.

Asynchronous Contact

Findings for life satisfaction, depressive symptoms, and health are all presented in separate tables for clarity.

Results for life satisfaction are found in Table 6. Model 1 showed adequate fit ($\chi^2(154) = 352.67$, $p < .001$, CFI = .96, TLI = .95). In Model 1, life satisfaction from Time 1 ($b = .67$, $p < .001$) and asynchronous contact ($b = .09$, $p < .05$), both showed links with increased life satisfaction. Model 2 showed adequate fit ($\chi^2(286) = 483.28$, $p < .001$, CFI = .96, TLI = .95). Both life satisfaction from Time 1 ($b = .67$, $p < .001$) and asynchronous contact ($b = .09$, $p < .05$) remained linked to life satisfaction once the control variables were added. Model 3 showed adequate fit ($\chi^2(286) = 493.57$, $p < .001$, CFI = .95, TLI = .94). In this final model, the interaction between asynchronous contact and autistic traits was significant ($b = .08$, $p < .05$). A test of simple slopes showed that for those higher in autistic traits there was no link between

asynchronous contact and life satisfaction ($b = .01, p = .92$). For those lower in autistic traits, asynchronous contact was linked to increased life satisfaction ($b = .17, p = .001$). These results followed the same pattern as the synchronous contact findings.

The results for depressive symptoms are found in Table 7. Model 1 showed adequate fit ($\chi^2(154) = 352.67, p < .001$, CFI = .96, TLI = .95). In Model 1, only the depressive symptoms from Time 1 ($b = .61, p < .001$) were linked to depressive symptoms. This remained unchanged when control variables were added in Model 2 ($b = .61, p < .001$), and sibling relatedness ($b = .29, p < .01$) as well as sibling relationship ($b = -.26, p < .01$) were linked- to depressive symptoms. Model 2 also showed adequate fit ($\chi^2(286) = 483.28, p < .001$, CFI = .96, TLI = .95). Model 3 showed adequate fit ($\chi^2(286) = 493.57, p < .001$, CFI = .95, TLI = .94). The interaction in Model 3 was significant ($b = .08, p < .05$). Simple slopes showed that for those higher in autistic traits there was no significant link between asynchronous contact and depressive symptoms ($b = .03\ p = .62$). Comparatively, for those with lower autistic traits, asynchronous contact was linked to decreased depressive symptoms ($b = -.14, p = .05$).

Results for health are found in Table 8. Only health from Time 1 was significant across all models; Model 1 ($b=.67, p<.001$) and Model 2 ($b=.66, p<.001$). The interaction was not significant in Model 3. All three Models showed suitable fit; Model 1 showed adequate fit ($\chi^2(154) = 352.67, p < .001$, CFI = .96, TLI = .95). Model 2 also showed adequate fit ($\chi^2(286) = 483.28, p < .001$, CFI = .96, TLI = .95). And Model 3 showed adequate fit ($\chi^2(286) = 493.57, p < .001$, CFI = .95, TLI = .94).

Discussion

Contact in young adulthood is important to well-being (Holt-Lunstad et al., 2010; Shor & Roelfs, 2015), especially when that contact is from a sibling (Bedford & Avioli, 2012; McCamish-Svensson et al., 1999; Sherman et al., 2006). Contact comes in different forms, either synchronous (e.g., in person visits) with instantaneous responses from both parties, or asynchronous (e.g., texting) with pauses between responses. These different types of contact may change how communication is perceived (Milevsky, 2019; Primack et al., 2017; Seabrook et al., 2016). The way each individual processes contact may depend on their own biopsychological characteristics and might differ based on autistic traits (Jobe & White, 2007; Wainer et al., 2013). The PPCT aspects of the bioecological model by Bronfenbrenner (1995) places each part of the interactions of sibling into a synergistic exchange that accounts for who they are as a person, how their repeated interactions impact them, the type of contact they use and the time they have spent together. This lens allows for a holistic perspective of who each person is and what their sibling contact means, and then to understand how it is linked to their well-being.

Sibling Contact and Well-Being

When young adult siblings are in contact with each other, this proximal-process fosters a deeper connection, which research has shown to have a multitude of benefits, including links to greater well-being (Bedford & Avioli, 2012; Holt-Lundstad, 2018; Shor & Roelfs, 2015). This study found that sibling contact overall, regardless of each person's autistic traits, was positively linked to greater life satisfaction. This shows that young adult sibling contact, regardless of synchronous or asynchronous, was connected to higher levels of life satisfaction. The contact from a sibling who has been an integral part of an individual's makeup through repeated direct

reciprocal interactions, was particularly positive in young adult reports of life satisfaction over time. Depressive symptoms were only significantly linked to synchronous contact, which showed lower depressive symptoms when siblings communicated through synchronous means. This indicates that for young adults, either seeing their sibling or talking on the phone with them is important to lower their depressive symptoms.

The types of contact, which changes the context siblings communicate in, did seem to have an influence on the results. Asynchronous contact on its own was significantly linked to higher life satisfaction, but none of the other well-being outcomes. Past research on asynchronous contact suggested mixed findings, and some even linked it to depressive symptoms (Bettmann et al., 2021; Primack et al., 2017; Seabrook et al., 2016). However, for sibling relationships, asynchronous contact did not have significant links to higher levels of depressive symptoms, but rather greater life satisfaction. This is encouraging in an era where most young adults are relying on social media and texting to communicate, perhaps the sibling relationships allows that particular communication to be a positive one because they are a significant other that has been a meaningful part of their context and involved in so many proximal processes over the life course.

Synchronous contact between siblings, on the other hand, was linked to both higher life satisfaction and lower depressive symptoms. This follows the patterns of positive influence found by previous research on synchronous contact in other relationships (Jin & Peña, 2010; Milevsky, 2019; Nilsson & Mattes, 2015). The ability to see or hear a sibling when communicating with them may be a universally comforting experience that gives young adults the opportunity to feel more life satisfaction and express lower depressive symptoms.

Although none of the predictors held significant links to health, there may still be connections there that would be more apparent over longer periods of time. Health may be much more stable than life satisfaction and depressive symptoms, particularly in young adults who are overall mostly healthy. The links between health and sibling communication could potentially become more apparent in later life or in future waves of data collection.

The Role of Autistic Traits

Each person has a unique set of personal traits and characteristics that can change how proximal processes (e.g., communication) are linked to their well-being. Due to the time spent together, and the shared context siblings have, their relationship may create a space that transcends biopsychological barriers. Synchronous contact had a significant connection with lower depressive symptoms in all the sample but did not have a significant interaction with autistic traits. Synchronous sibling contact is possibly a potent way to offset depressive symptoms in all young adults, regardless of their biopsychological characteristics and personal traits. Autistic traits do did not change how siblings internalize synchronous contact when it comes to depressive symptoms; all of the participants in this sample responded in a similar pattern. The context of synchronous sibling communication may be particularly powerful to nullify each person's characteristics that would typically change how communication is absorbed.

These results also revealed that with sibling communication, autistic traits do not moderate the link to life satisfaction, depressive symptoms, and health. Each significant interaction was only meaningful for those in lower autistic traits as a link to higher life satisfaction or lower depressive symptoms. Autistic traits were not associated with lower levels

of life satisfaction or higher depressive symptoms, which previous research would have expected from other relationships. Autistic traits tend to change how young adults absorb relationship contact; for romantic relationships, those with higher levels of traits have reported more loneliness while in romantic relationships (Jobe & White, 2007), they also report lower levels of empathy and less secure romantic attachments (Lamport & Turner, 2014). This is encouraging and shows the unique context of a sibling bond, even when higher levels of autistic traits are present. The shared history of siblings may make their contact to each other different than romantic partners or friends, and those with high levels of autistic traits who would otherwise be disadvantaged by contact from romantic partners or friends, did not report negative links from their sibling contact. When most contact, regardless of synchronous or asynchronous context, is negatively linked to well-being, siblings can be a safe and neutral communication outlet.

It is also interesting to note that although the highest AQ score in the current sample was 28; 30 is considered a rough cutoff that may correspond with a clinical ASD diagnosis (Baron-Cohen et al., 2001). Despite the low levels of autistic traits in the current sample, there were still clear patterns between those of high and low levels of autistic traits. This shows the importance of researching not only autism, but autistic traits in general and how they may be impacting that community differently than others, regardless of diagnosis. This is especially true since autism diagnoses can be difficult to obtain based on gender, cost, and clinician availability or training. Instead of allowing others to gatekeep the community of autism, those who are high in traits may still wish to identify as autistic and benefit from the community through self-identification.

Limitations and Conclusions

Despite the rigor of this study, there were a few limitations that future research could improve upon. The sample for this project, although quite large, was an online convenience sample and therefore the results should be interpreted with this convenience in mind. Additionally, all the information collected was through each individual's self-report. Future expansion of this topic would benefit from accompanying sibling reports. Unfortunately, the communication measures did not consider collecting data about FaceTime frequency, which would have been a valuable addition to the synchronous contact section. Retention was also poor between time 1 and time 2, and it would have been much better to maintain the large sample size that originally started the process. Further, the sample included reports about all the siblings each individual had, and I only used the one closest in age to keep the analysis parsimonious.

Despite these limitations, this thesis contributes to the broader literature. Sibling relationships in young adulthood are positively linked to well-being through both synchronous and asynchronous means of contact. Specifically, sibling communication, regardless of context and autistic traits, is positively linked with greater life satisfaction over time. Depressive symptoms were also significantly lower for those who communicate with their siblings through face-to-face interactions or over the phone, regardless of personal characteristics. This is important information in an age where so much communication takes place over text and social media. Finally, social contact in most relationships is significantly negative for those who have high levels of autistic traits, but this thesis found that with siblings, this type of contact is actually neutral. The synergy of young adult siblings communicating through various means over the span of one year creates a way for those with autistic traits to experience their sibling

relationship differently than they do other close relationships. Parents and clinicians working

with young adults may want to encourage siblings to have contact, and especially to be with one

another as a way of improving young adults' well-being.

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Appendix A

Table 1 – Descriptive statistics

	Mean	Std Dev	Range
Life Satisfaction T1	4.73	1.61	1-7
Life Satisfaction T2	4.74	1.63	1-7
Health T1	3.55	.98	1-5
Health T2	3.58	.97	1-5
Depressive Symptoms T1	1.67	.79	1-4
Depressive Symptoms T2	1.67	.85	1-4
Autistic Traits	16.77	3.32	8-28
Synchronous	3.99	2.06	0-8
Asynchronous	3.51	2.01	0-8
General Contact	5.35	2.11	0-8
Gender	.39	.49	0-1
Married	.29	.46	0-1
Ethnicity	.71	.45	0-1
Sibship	.15	.37	0-1
Age	25.65	2.39	19-29
Sibling Relationship	1.20	.53	1-4
Birth Order	.51	.50	0-1
Age Difference	4.11	3.43	0-23
Sex Composition	.52	.5	0-1

Gender: 0=female, 1=male; Married: 0=not married, 1= married; Ethnicity: 0=Caucasian, 1=not Caucasian; Education: 1= none, 2=elementary, 3=some high school, 4=high school, 5=vocational, 6=graduate, 7=post college, 8=other; Sibship 0=one sibling, 1=two or more; Sibling Relationship: 1=full biological, 2=half siblings, 3=adoptive, 4=step-siblings; Birth order: 1=participant older than sibling, 0=participant younger or equal; Sex Composition 0 = both siblings same gender, 1 = different gender.
* $p<.05$, **$p <.01$, ***$p <.001$

Table 2: Correlations of all independent and dependent variables

	Life Satisfaction T2	Health T2	Depressive Symptoms T2	General Contact	Synchronous Contact	Asynchronous Contact	Autism Traits
Life Satisfaction T2	-						
Health T2	.45***	-					
Depressive Symptoms T2	-.57***	-.37***	-				
General Contact	.01	.06	-.07	-			
Synchronous Contact	.13*	.14**	-.14**	.74***	-		
Asynchronous Contact	.17***	.14**	-.09	.61***	.67***	-	
Autistic Traits	-.09	-.15**	.15**	-.01	-.16**	-.11*	-

* $p < .05$, ** $p < .01$, *** $p < .001$

Table 3 – Standardized SEM results for Life Satisfaction & Synchronous Contact

Life Satisfaction T2	Model 1		Model 2		Model 3	
	b	SE	b	SE	b	SE
Synchronous contact	.08*	.04	.09*	.04	.09*	.04
Autistic Traits	-.04	.04	-.03	.04	-.04	.04
Life Satisfaction T1	.68***	.03	.67***	.03	.66***	.03
Autistic Traits X Synchronous	-	-	-	-	-.08*	.04
Male	-	-	-.07	.04	-.06	.04
Married	-	-	.04	.04	.03	.04
Ethnicity	-	-	.05	.04	.05	.04
Education	-	-	-.06	.04	-.06	.04
Sibship	-	-	-.09	.08	-.09	.08
Age	-	-	.01	.04	.01	.04
Sibling Relationship	-	-	.04	.08	.04	.08
Birth Order	-	-	-.06	.04	-.06	.04
Age Difference	-	-	.02	.04	.03	.04
Sex Composition	-	-	.02	.04	.03	.04
R^2	.48***		.49***		.51***	

Male: 0=female, 1=male; Married: 0=not married, 1= married; Ethnicity: 0=Caucasian, 1=not Caucasian; Education: 1= none, 2=elementary, 3=some high school, 4=high school, 5=vocational, 6=graduate, 7=post college, 8=other; Sibship 0=one sibling, 1=two or more; Sibling Relationship: 1=full biological, 2=half siblings, 3=adoptive, 4=step-siblings; Birth order: 1=participant older than sibling, 0=participant younger or equal, Sex Composition: 0=same, 1=different.

 * $p<.05$, **$p <.01$, ***$p <.001$

Table 4 – Standardized SEM results for Depressive Symptoms & Synchronous Contact

Depressive Symptoms T2	Model 1		Model 2		Model 3	
	b	SE	b	SE	b	SE
Synchronous contact	-.10*	.04	-.11**	.04	-.11*	.04
Autistic Traits	.04	.04	.03	.04	.03	.04
Depressive Symptoms T1	.61***	.03	.61***	.04	.60***	.04
Autistic Traits X Synchronous	-	-	-	-	.08	.04
Male	-	-	-.01	.04	-.02	.04
Married	-	-	-.03	.04	-.03	.04
Ethnicity	-	-	-.06	.04	-.06	.04
Education	-	-	.03	.04	.04	.04
Sibship	-	-	.29**	.09	.29**	.09
Age	-	-	-.07	.04	-.08	.04
Sibling Relationship	-	-	-.27**	.09	-.27**	.09
Birth Order	-	-	-.03	.04	-.03	.04
Age Difference	-	-	.01	.04	-.01	.04
Sex Composition	-	-	-.01	.04	-.01	.04
R^2	.40***		.42***		.44***	

Male: 0=female, 1=male; Married: 0=not married, 1= married; Ethnicity: 0=Caucasian, 1=not Caucasian; Education: 1= none, 2=elementary, 3=some high school, 4=high school, 5=vocational, 6=graduate, 7=post college, 8=other; Sibship 0=one sibling, 1=two or more; Sibling Relationship: 1=full biological, 2=half siblings, 3=adoptive, 4=step-siblings; Birth order: 1=participant older than sibling, 0=participant younger or equal, Sex Composition: 0=same, 1=different.

 * $p<.05$, ** $p <.01$, *** $p <.001$

Table 5 – Standardized SEM results for Health & Synchronous Contact

Health T2	Model 1		Model 2		Model 3	
	b	SE	*b*	SE	*b*	SE
Synchronous contact	.03	.04	.02	.04	.02	.04
Autistic Traits	-.06	.04	-.06	.04	-.06	.04
Health T1	.67***	.03	.66***	.03	.66***	.03
Autistic Traits X Synchronous	-	-	-	-	-.03	.04
Male	-	-	.04	.04	.05	.04
Married	-	-	.00	.04	.00	.04
Ethnicity	-	-	-.01	.04	-.01	.04
Education	-	-	-.01	.04	-.01	.04
Sibship	-	-	-.10	.08	-.10	.08
Age	-	-	.00	.04	.01	.04
Sibling Relationship	-	-	.05	.08	.05	.08
Birth Order	-	-	-.03	.04	-.03	.04
Age Difference	-	-	.06	.04	.06	.04
Sex Composition	-	-	.01	.04	.01	.04
R^2	.47***		.48***		.48***	

Male: 0=female, 1=male; Married: 0=not married, 1= married; Ethnicity: 0=Caucasian, 1=not Caucasian; Education: 1= none, 2=elementary, 3=some high school, 4=high school, 5=vocational, 6=graduate, 7=post college, 8=other; Sibship 0=one sibling, 1=two or more; Sibling Relationship: 1=full biological, 2=half siblings, 3=adoptive, 4=step-siblings; Birth order: 1=participant older than sibling, 0=participant younger or equal; Sex Composition: 0=same, 1=different.

 * $p<.05$, ** $p <.01$, *** $p <.001$

Table 6 – Standardized SEM results for Life Satisfaction & Asynchronous Contact

Life Satisfaction T2	Model 1		Model 2		Model 3	
	b	SE	b	SE	b	SE
Asynchronous contact	.08*	.04	.09*	.04	.09*	.04
Autistic Traits	-.05	.04	-.04	.04	-.04	.04
Life Satisfaction T1	.67***	.03	.67***	.03	.66***	.03
Autistic Traits X Asynchronous	-	-	-	-	-.08*	.04
Male	-	-	-.06	.04	-.05	.04
Married	-	-	.03	.04	.03	.04
Ethnicity	-	-	.05	.04	.05	.04
Education	-	-	-.07	.04	-.08*	.04
Sibship	-	-	-.09	.08	-.09	.08
Age	-	-	.01	.04	.01	.04
Sibling Relationship	-	-	.04	.08	.04	.08
Birth Order	-	-	-.06	.04	-.06	.04
Age Difference	-	-	.02	.04	.03	.04
Sex Composition	-	-	.03	.04	.03	.04
R^2	.48***		.49***		.51***	

Male: 0=female, 1=male; Married: 0=not married, 1= married; Ethnicity: 0=Caucasian, 1=not Caucasian; Education: 1= none, 2=elementary, 3=some high school, 4=high school, 5=vocational, 6=graduate, 7=post college, 8=other; Sibship 0=one sibling, 1=two or more; Sibling Relationship: 1=full biological, 2=half siblings, 3=adoptive, 4=step-siblings; Birth order: 1=participant older than sibling, 0=participant younger or equal, Sex Composition: 0=same, 1=different.

* $p<.05$, **$p <.01$, ***$p <.001$

Table 7 – Standardized SEM results for Depressive Symptoms & Asynchronous Contact

Depressive Symptoms T2	Model 1		Model 2		Model 3	
	b	SE	b	SE	b	SE
Asynchronous contact	-.05	.04	-.06	.04	-.06	.04
Autistic Traits	.05	.04	.04	.04	.04	.04
Depressive Symptoms T1	.61***	.04	.61***	.04	.60***	.04
Autistic Traits X Asynchronous	-	-	-	-	.08*	.04
Male	-	-	-.02	.04	-.03	.04
Married	-	-	-.02	.04	-.02	.04
Ethnicity	-	-	-.06	.04	-.06	.04
Education	-	-	.05	.04	.05	.04
Sibship	-	-	.29**	.09	.29**	.09
Age	-	-	-.07	.04	-.07	.04
Sibling Relationship	-	-	-.26**	.09	-.26**	.09
Birth Order	-	-	-.02	.04	-.02	.04
Age Difference	-	-	.00	.04	-.01	.04
Sex Composition	-	-	-.00	.04	-.01	.04
R^2	.40***		.42***		.43***	

Male: 0=female, 1=male; Married: 0=not married, 1= married; Ethnicity: 0=Caucasian, 1=not Caucasian; Education: 1= none, 2=elementary, 3=some high school, 4=high school, 5=vocational, 6=graduate, 7=post college, 8=other; Sibship 0=one sibling, 1=two or more; Sibling Relationship: 1=full biological, 2=half siblings, 3=adoptive, 4=step-siblings; Birth order: 1=participant older than sibling, 0=participant younger or equal, Sex Composition: 0=same, 1=different.

 * $p<.05$, ** $p <.01$, *** $p <.001$

Table 8 – Standardized SEM results for Health & Asynchronous Contact

Health T2	Model 1		Model 2		Model 3	
	b	SE	b	SE	b	SE
Asynchronous contact	.01	.04	.01	.04	.01	.04
Autistic Traits	-.06	.04	-.07	.04	-.07	.04
Health T1	.67***	.03	.66***	.03	.66***	.03
Autistic Traits X Asynchronous	-	-	-	-	-.03	.04
Male	-	-	.04	.04	.05	.04
Married	-	-	.00	.04	.00	.04
Ethnicity	-	-	-.01	.04	-.01	.04
Education	-	-	-.01	.04	-.01	.04
Sibship	-	-	-.10	.08	-.10	.08
Age	-	-	.00	.04	.01	.04
Sibling Relationship	-	-	.05	.08	04	.08
Birth Order	-	-	-.03	.04	-.03	.04
Age Difference	-	-	.06	.04	.06	.04
Sex Composition	-	-	.01	.04	.01	.04
R^2	.47***		.48***		.48***	

Male: 0=female, 1=male; Married: 0=not married, 1= married; Ethnicity: 0=Caucasian, 1=not Caucasian; Education: 1= none, 2=elementary, 3=some high school, 4=high school, 5=vocational, 6=graduate, 7=post college, 8=other; Sibship 0=one sibling, 1=two or more; Sibling Relationship: 1=full biological, 2=half siblings, 3=adoptive, 4=step-siblings; Birth order: 1=participant older than sibling, 0=participant younger or equal, Sex Composition: 0=same, 1=different.

* $p<.05$, **$p <.01$, ***$p <.001$

Appendix B

Figure 1