Article

Not peer-reviewed version

The Mediating Role of Human-Animal Bond in the Relationship Between Depressive Symptoms and Subjective Well-Being: The Moderating Effect of Pet Attachment

Jiyu Sung *

Posted Date: 2 September 2025

doi: 10.20944/preprints202509.0143.v1

Keywords: depressive symptoms; subjective well-being; human-animal bond; pet attachment; animal-assisted therapy; mental health improvement

Article

The Mediating Role of Human-Animal Bond in the Relationship Between Depressive Symptoms and Subjective Well-Being: The Moderating Effect of Pet Attachment

Jiyu Sung

Department of Companion Animals, Dongwon University, Gyeonggi-do 12813, Republic of Korea; iacaroma@tw.ac.kr; Tel.: +82-10-8731-4359)

Simple Summary

Understanding how pets influence mental health is important for promoting well-being in society. In this study, we used a self-report questionnaire to examine whether having a close relationship with a pet can help reduce the negative effects of depression and improve happiness. Most participants reported feeling emotionally supported by their pets, and those with stronger bonds experienced less psychological stress and greater well-being. However, this benefit was mainly associated with direct and meaningful interactions with pets, rather than simply feeling attached. We found no significant differences between dog and cat owners, suggesting that the quality of the human-animal relationship matters more than the type of pet. These findings highlight the value of positive interactions with pets for emotional support. Encouraging pet adoption, animal-assisted therapy, and community activities involving pets may help improve mental health and quality of life for many people. By showing how pets can provide comfort and stability, this research offers practical insights for developing programs and policies that support well-being.

Abstract

This study examines the complex relationships among depressive symptoms, subjective well-being, pet attachment, and the human-animal bond. Using a moderated mediation model, we investigated whether pet attachment mediates the negative impact of depressive symptoms on subjective well-being, and whether the human-animal bond moderates these effects. Data were collected from 391 companion animal owners in South Korea and analyzed using Hayes's Process Macro. Results indicated that pet attachment partially mediated the negative effects of depressive symptoms on subjective well-being, highlighting the emotional stability and stress relief that pets can provide. Additionally, the human-animal bond moderated the direct relationship between depressive symptoms and subjective well-being, demonstrating its protective role against psychological stress. However, its moderating effect on the indirect pathway through pet attachment was not statistically significant, suggesting that direct interactions with pets are particularly important for emotional comfort. No significant differences were found between dog and cat owners, indicating that the quality of the human-animal bond is more important than pet type in conferring psychological benefits. These findings suggest that strengthening human-animal relationships may be an effective strategy for improving mental health and well-being, with meaningful implications for clinical interventions and policy development.

Keywords: depressive symptoms; subjective well-being; human-animal bond; pet attachment; animal-assisted therapy; mental health improvement

 doi:10.20944/preprints202509.0143.v1

1. Introduction

Contemporary society is undergoing rapid demographic and social transformations, including in-creased life expectancy, the prevalence of nuclear families, declining birth rates, population aging, and a rise in single-person households. These changes have weakened social networks, exacerbated loneliness, and heightened social isolation, contributing to the growing prevalence of mental health issues such as depression[1]. Within this context, companion animals have emerged as a promising resource for enhancing emotional stability and subjective well-being. During the COVID-19 pandemic, the adoption of pets increased significantly as a strategy to mitigate social isolation, highlighting their potential to positively impact emotional resilience and mental health[2]. In South Korea, the perception of pets as family members has be-come increasingly widespread, underscoring their evolving role and significance in modern society[3,4]

1.1. The Human-Animal Bond and Emotional Stability

The human-animal bond refers to the dynamic and reciprocal relationship between humans and their companion animals, characterized by emotional connections and meaningful interactions. This bond has been shown to enhance psychological well-being, improve physical health, and strengthen social relationships[5,6]. Pets are increasingly regarded not as mere possessions but as integral members of the family and sources of emotional support, making them a critical focus of contemporary research[4].

Pet attachment, in particular, reflects a modern understanding of animals as extensions of personal identity and self-concept[4,7]. This perspective aligns with attachment theory, originally developed to explain human interpersonal relationships, which has since been extended to include relationships with non-human entities[8,9]. Healthy attachment to pets has been associated with improved emotional regulation, reduced stress, and increased overall happiness, emphasizing the therapeutic potential of these bonds[10,11].

1.2. The Evolution of the Concept of Pets and Global Trends

The relationship between humans and animals dates back approximately 14,000 years, when wolves, the ancestors of modern dogs, first coexisted with humans[12]. Over time, animals transitioned from being tools for survival to valued companions, with some cultures, such as ancient Egypt, even venerating them[13]. The term "pet" originates from the French word "petit," initially referring to animals kept for pleasure and companionship[14]. In modern contexts, the term "companion animal" reflects the deeper emotional and social roles pets play in human lives[4].

Recent decades have witnessed a global surge in pet ownership, driven by shifting societal perceptions, demographic changes, rising incomes, and events such as the COVID-19 pandemic[15–18]. As of 2021, over one billion companion animals were reported worldwide, with dogs being the most popular, followed by cats and fish[19,20]. In aging societies such as Japan, pets have been recognized for their positive impact on the emotional well-being of older adults, leading to the widespread adoption of animal-assisted therapy[20]. Similarly, South Korea has experienced a rapid increase in pet ownership, accompanied by a growing recognition of pets as family members rather than mere companions[3,19].

1.3. Pets and Mental Health

Companion animals play a pivotal role in mental health by providing nonjudgmental emotional support and facilitating social interactions, which can alleviate symptoms of depression[2,21–26]. These effects are particularly pronounced among socially isolated individuals, such as older adults, where strong attachment to pets has been shown to significantly reduce depressive symptoms[23,24,27,28]. Animal-assisted therapy has demonstrated efficacy in reducing depression and anxiety across various settings, including long-term care facilities[23,24,27]. However, the therapeutic value of pet ownership is not universal and may be influenced by factors such as time

 doi:10.20944/preprints202509.0143.v1

constraints or individual differences[29]. These findings underscore the complexity of the human-animal bond and the need for further research to explore its therapeutic potential.

Depression is characterized by persistent sadness and a loss of interest in previously enjoyable activities and is a significant factor undermining subjective well-being[30–32]. Conversely, high levels of subjective well-being are associated with life satisfaction, happiness, and positive emotional states, serving as critical indicators of mental health[33]. Emerging research suggests that relationships with pets can alleviate depressive symptoms and enhance subjective well-being, offering a valuable resource for improving mental health outcomes[34–41].

Strong attachment to pets has been linked to enhanced emotional well-being and greater happiness, with pets often functioning as extensions of an individual's self-concept[42,43]. Companion animals, particularly dogs, engage with humans through behaviors such as eye contact, vocalizations, and gestures, fulfilling emotional needs and fostering a sense of security[44–46]. This phenomenon, commonly referred to as the "Companion animal effect," highlights the profound emotional support pets provide and their potential to enhance mental health and well-being[46–50].

This study aims to investigate the mediating role of the human-animal bond in the relationship between depression and subjective well-being, as well as the moderating effect of pet attachment. By examining the interactions among depression, the human-animal bond, and subjective well-being, this research seeks to propose strategies for leveraging pets as a resource for emotional support. Ultimately, the findings aim to contribute to the development of interventions that enhance mental health and subjective well-being in contemporary society.

This manuscript is an original research article that examines the mediating role of the human-animal bond in the relationship between depression and subjective well-being, along with the moderating effect of pet attachment. The study employs a quantitative research design using survey methodology to collect data from participants. Statistical analyses are conducted to explore the interactions among depression, the human-animal bond, and subjective well-being.

2. Materials and Methods

2.1. Ethics Statements

Ethical approval for this study was obtained from the Institutional Bioethics Committee of Konkuk University (IRB, project number: 7001355-202404-HR-788) in May 2024, in compliance with the Declaration of Helsinki.

2.2. Study Design

This study employs a cross-sectional survey design to explore the mediating role of the human-animal bond in the relationship between depression and subjective well-being, as well as the moderating effect of pet attachment.

The survey included validated scales to measure depression, subjective well-being, the human-animal bond, and pet attachment. Participation in the study was voluntary, and informed consent was obtained electronically before participants accessed the questionnaire. The use of an online survey ensured accessibility and convenience for participants, while also facilitating the collection of a diverse sample. Statistical analyses, including mediation and moderation analyses, were performed to test the proposed hypotheses and examine the relationships among variables.

The research model is as follows. (Figure 1)

 doi:10.20944/preprints202509.0143.v1

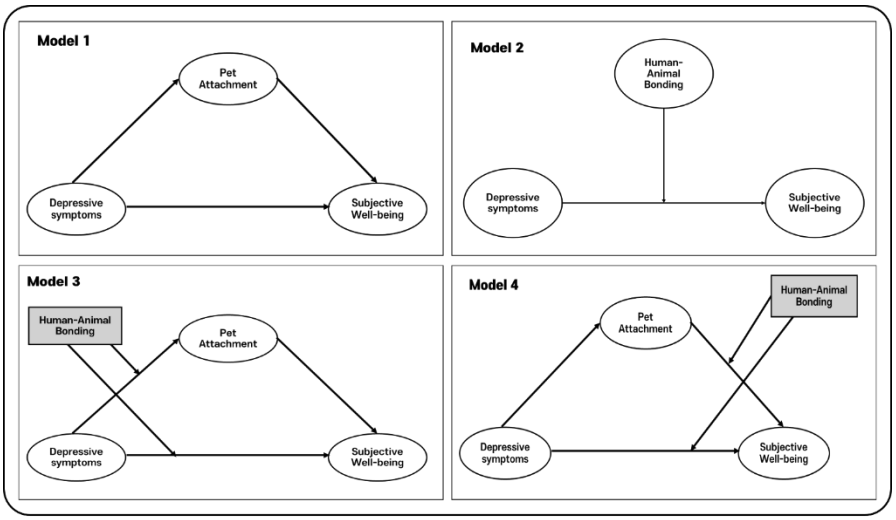


Figure 1. Research models depicting mediating, moderating, mediated moderation, and moderated mediation effects in the relationships among depressive symptoms, human-animal bond, pet attachment, and subjective well-being. Model 1 examines the mediating effect of the human-animal bond, while Model 2 explores the moderating role of pet attachment. Models 3 and 4 investigate mediated moderation and moderated mediation, respectively.

H1: There is a negative association between depressive symptoms and subjective well-being.

H2: The human-animal bond mediates the relationship between depressive symptoms and subjective well-being.

H3: Pet attachment moderates the relationship between depressive symptoms and the human-animal bond.

H4: Pet attachment moderates the indirect effect of depressive symptoms on subjective well-being via the human-animal bond.

2.3. Data Collection

Data were collected through an online survey conducted on May 21, 2024. The survey targeted individuals aged 20 years or older residing in the Seoul metropolitan area of South Korea, which includes Seoul, Gyeonggi Province, and the city of Incheon. Participants were recruited through the researcher's personal blog and Instagram account. A total of 400 responses were collected on the same day, and after excluding incomplete responses, 391 valid responses were included in the final analysis.

2.4. Participants

The study participants consisted of 391 adults aged 20 years or older who reside in the Seoul metropolitan area, including Seoul, Gyeonggi Province, and the city of Incheon. All participants were pet owners, owning animals such as dogs or cats. The sample was diverse in terms of demographic characteristics, which were analyzed to ensure representativeness within the target population.

2.5. Measures

This study employed four measurement tools to assess various psychological and behavioral con-structs relevant to its objectives.

The Center for Epidemiologic Studies Depression Scale (CES-D), developed by Radloff[51] and validated in Korean by Jeon[52], was employed to assess depressive symptoms among the study participants. This scale is a widely recognized tool for evaluating the prevalence and severity of depressive symptoms across diverse populations.

The Lexington Attachment to Pets Scale (LAPS), originally developed by Johnson[53], was used in a modified format to evaluate attachment to companion animals. The re-vised version, which was

 doi:10.20944/preprints202509.0143.v1

translated into Korean by Sung and Han[4], consisted of 18 items categorized into two subfactors: General Attachment and People Substituting.

The Companion Animal Bonding Scale (CABS), originally developed by Poresky[54], was utilized to measure the emotional bond between humans and their companion animals. The scale has been widely used in previous studies and was translated into Korean for this research to ensure cultural appropriateness.

Finally, the Concise Measure of Subjective Well-Being (COMOSWB), developed by Seo and Koo[55], was employed to measure subjective well-being. This tool provides a com-prehensive yet concise assessment of well-being, making it particularly appropriate for this study.

All instruments were selected for their established validity and cultural adaptability, ensuring reliable and relevant measurements within the context of this research. Responses for each item were recorded on a 5-point Likert scale, ranging from 1 (never felt) to 5 (always felt), with higher scores indicating greater levels of the measured construct.

2.6. Statistical Analysis

In this study, frequency analysis and descriptive statistics were conducted to evaluate the characteristics of the sample and identify trends in the key variables (depressive symptoms, attachment to pets, human-animal bond, and subjective well-being). Descriptive statistics included means (M), standard deviations (SD), skewness, and kurtosis to assess the normality of the data and determine whether it met the assumptions of a normal distribution. Pearson correlation analysis was used to examine the relationships among the key variables.

To determine control variables for the mediation, moderation, and moderated mediation analyses, independent sample t-tests and one-way ANOVA were conducted. For significant group differences, Scheffé's post-hoc test was used. If the assumption of homogeneity of variance was violated, Welch's ANOVA and Games-Howell post-hoc tests were applied. Finally, simple and multiple linear regression analyses identified significant control variables, such as education level and income status. Only significant variables were presented in the tables and results to ensure clarity and focus.

To assess the significance of mediation, moderation, and moderated mediation effects while controlling for relevant variables, Hayes's[56] analytical framework was applied. The analyses were conducted using SPSS Process Macro version 4.2 with 5,000 bootstrap samples.

Mediation analysis used Model 4, moderation analysis applied Model 1, and moderated mediation analysis employed Models 8 and 15.

The significance of indirect and moderation effects was evaluated using 95% confidence intervals (CIs), with effects deemed significant if the CIs excluded zero[57]. The Johnson-Neyman technique was also applied to explore moderation effects, identifying thresholds where the human-animal bond significantly moderated the relationships.

To facilitate the interpretation of interaction effects and reduce correlations between variables, all independent and control variables were mean-centered. Bootstrapping was employed to overcome the limitations of traditional methods such as the Sobel test and to avoid reliance on normality assumptions.

3. Results

3.1. Frequency Analysis

To analyze differences in human-animal bonding, depressive symptoms, subjective well-being among pet owners, frequency analysis was conducted on the demographic characteristics of 391 participants. (Table A1)

Of the respondents, 65% were female, and 35% were male. Most participants were in their 30s (47.8%) or 20s (31.2%), with 79% aged under 40. Regarding education, 61.1% held a bachelor's degree or higher. Employment status showed 38% were employed, 17.1% self-employed, and 4.9% students.

 doi:10.20944/preprints202509.0143.v1

Income data revealed 85.2% had an income, with 39.1% earning $2,000–$3,000 monthly. Marital status indicated 69.1% were unmarried.

For pet ownership, 70.1% owned dogs, 26.9% cats, and 3.1% both. First-time pet owners accounted for 75.4%, and 87.5% owned one pet. Most pets were aged 3–6 years (43.7%), and 40.2% of participants had owned their pets for 3 years or less.

In this study, only statistically significant demographic variables are reported in the table and text to ensure clarity and focus on meaningful findings.

3.2. Reliability and Validity of Psychometric Scales

To assess the reliability of the measurement scales, Cronbach's α coefficients were calculated for each scale (Tables 1 and 2).

Table 1. Reliability Analysis of Measurement Scales.

n=391

Measure	Number of Items	*Chrobach's α*
Depressive Symptoms Measure	20	0.971
Pet Attachment Measure	18	0.914
Human- Animal Bonding Measure	8	0.829
Subjective Well-Being Measure	9	0.867

Table 2. Model Fit Indices for the Confirmatory Factor Analysis(CFA) of the Lexington Pet Attachment Scale (LAPS).

n=391

Fit Indices	Value	Acceptable Threshold
CFI	0.966	≥ 0.90 (Good), ≥ 0.95 (Excellent)
TLI	0.961	≥ 0.90 (Good), ≥ 0.95 (Excellent)
RMSEA	0.041	< 0.06 (Good), < 0.08 (Acceptable)
SRMR	0.034	< 0.08
χ^2	222 (df = 134, p< .001)	*Non-significant preferred; sensitive to sample size*

The results indicated satisfactory internal consistency across all measures. The Companion Animal Bonding Scale (CABS) demonstrated a Cronbach's α coefficient of 0.829, reflecting strong internal consistency.

The Center for Epidemiologic Studies Depression Scale (CES-D) exhibited exceptionally high reliability, with a Cronbach's α coefficient of 0.971.

The Lexington Attachment to Pets Scale (LAPS) showed an overall Cronbach's α coefficient of 0.914, with subfactor reliabilities of 0.868 for General Attachment and 0.799 for People Substituting. Confirmatory factor analysis (CFA) for the LAPS revealed a robust model fit, with CFI = 0.966, TLI = 0.961, RMSEA = 0.041, and SRMR = 0.034, all meeting the recommended thresholds.

Lastly, the Concise Measure of Subjective Well-Being (COMOSWB) demonstrated strong reliability, with a Cronbach's α coefficient of 0.867. Collectively, these findings confirm the reliability and validity of the scales utilized in this study.

3.3. Descriptive Statistics

 doi:10.20944/preprints202509.0143.v1

The results, summarized in Table 3, provide a detailed overview of the distribution and variability of the variables included in the study (n = 391). (Table 3)

Table 3. Descriptive Statistics for Independent, Mediator, Moderator, Control, and depressive symptoms.

n=391

Variable Types	Variable Names	*M*	*SD*	*Skewness*	*Kurtosis*
Independent Variable	Depressive Symptoms	1.759	0.837	1.763	2.114
Mediator Variable	Pet Attachment	4.275	0.517	-2.157	6.567
Moderator Variable	Human-Animal Bonding	4.279	0.538	-1.720	3.924
Control Variable	Education Level	2.504	0.787	-0.837	-0.402
	Income Status	1.852	0.356	-1.986	1.956
Dependent Variable	Subjective Well-Being	4.263	0.563	-2.096	5.304

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

For the independent variable, depressive symptoms, the mean (M) was 1.759, the standard deviation (SD) was 0.837, with skewness and kurtosis values of 1.763 and 2.114, respectively. Similarly, the mediating variable (pet attachment) had an M of 4.275 and an SD of 0.517, with skewness and kurtosis values of -2.157 and 6.567. The moderating variable (human-animal bonding) showed an M of 4.279 and an SD of 0.538, with skewness and kurtosis values of -1.720 and 3.924. Among the control variables, education level had an M of 2.504 and an SD of 0.787, with skewness and kurtosis values of -0.837 and -0.402, while income status had an M of 1.852 and an SD of 0.356, with skewness and kurtosis values of -1.986 and 1.956. The dependent variable, subjective well-being, showed an M of 4.263 and an SD of 0.563, with skewness and kurtosis values of -2.096 and 5.304.

The results satisfied the assumption of normality, as all absolute skewness and kurtosis values were within Kline's[58] recommended thresholds of < 3.0 and < 7.0, respectively.

3.4. Pearson Correlation Analysis of Variable Relationships

Table 4 presents a correlation matrix examining the relationships among psychological, behavioral, and environmental constructs related to human-animal bonding and well-being (n = 391). Correlation coefficients are reported with significance levels (*p < .05, **p < .01, ***p < .001). (Table 4)

Table 4. Summary of Key Pearson Correlations Relevant to the Study Variables.

n=391

	Depressive Symptom	Pet Attachment	Human- Animal Bonding	Education Level	Income Status	Subjective Well-Being
Depressive Symptoms	1					
Pet Attachment	-0.581**	1				
Human- Animal Bonding	-0.461**	0.774**	1			
Education Level	0.090	0.183**	0.193**	1		
Income Status	0.010	0.176**	0.124*	0.377**	1	
Subjective Well-Being	-0.619**	0.761**	0.730**	0.074	0.188**	1

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

 doi:10.20944/preprints202509.0143.v1

Depressive symptoms were negatively correlated with pet attachment ($r = -0.581$, $p < .001$), human-animal bonding ($r = -0.461$, $p < .001$), and subjective well-being ($r = -0.619$, $p < .001$). These results indicate that higher levels of depressive symptoms are associated with lower levels of pet attachment, human-animal bonding, and subjective well-being.

Pet attachment exhibited strong positive correlations with human-animal bonding ($r = 0.774$, $p < .001$) and subjective well-being ($r = 0.761$, $p < .001$), suggesting that stronger attachment to pets is linked to greater well-being and stronger bonds with animals. Additionally, pet attachment was positively associated with education level ($r = 0.183$, $p < .01$) and income status ($r = 0.176$, $p < .001$).

Human-animal bonding was positively correlated with subjective well-being ($r = 0.730$, $p < .001$) and showed smaller but significant positive correlations with education level ($r = 0.193$, $p < .001$) and income status ($r = 0.124$, $p < .05$).

Education level was positively associated with income status ($r = 0.377$, $p < .01$). However, its relationships with depressive symptoms ($r = 0.090$) and subjective well-being ($r = 0.074$) were not statistically significant. Income status, on the other hand, was positively correlated with subjective well-being ($r = 0.188$, $p < .01$), while its association with depressive symptoms ($r = 0.010$) was negligible.

Overall, the findings underscore the critical role of pet attachment and human-animal bonding in promoting subjective well-being and mitigating depressive symptoms. These constructs are also meaningfully associated with socioeconomic factors such as education and income.

3.5. Mean Difference Analysis by Demographic Characteristics

3.5.1. Association Between Demographic Variables and Depressive Symptoms

The analysis reveals significant differences in pet attachment across demographic variables. (Table 5)

Table 5. Differences in Depressive Symptoms by Demographic Characteristics.

Outcome Variable		*N*	*M*	*SD*	*t/F*	*p*	*Post-hoc*
Gender	Male	137	4.15	0.58	-3.385***	.001	
	Female	254	4.35	0.502			
Age Group	20 to 29 years old [a]	122	1.45	0.433	15.604***	.001	*c>a*
	30 to 39 years old [b]	187	1.91	0.973			
	40 to 49 years old [c]	57	2.03	0.955			
	50 to 59 years old [d]	25	1.52	0.245			
Occupation	Student [a]	19	1.38	0.254	10.084***	.001	*d>a*
	Office Worker [b]	266	1.78	0.893			
	Self-employment [c]	67	1.68	0.684			
	Other(unemployed) [d]	39	1.91	0.816			
Marital Status	Married	121	1.91	0.911	2.312*	.022	
	Single(non-marital)	270	1.69	0.793			
Monthly Income	Less than $1,500 [a]	41	1.92	0.797	7.599***	.001	*a>b*
	$1,500 and $2,000 [b]	145	1.53	0.601			
	$2,000 and $3,000 [c]	153	1.89	0.982			
	Over $ 3,000 [d]	52	1.88	0.848			
	First	295	1.82	0.883	2.866**	.005	

 doi:10.20944/preprints202509.0143.v1

Pet ownership Experience	Second over	96	1.58	0.646			
Pet Age	< 3 years old [a]	151	1.92	0.963	5.407**	.002	*a>d*
	4 to 6 years old [b]	171	1.68	0.798			
	7 to 9 years old [c]	51	1.62	0.573			
	>10 years old [d]	18	1.5	0.311			
Duration of Pet Ownership	< 3 years [a]	157	1.93	0.975	15.352***	.001	*a>d*
	4 to 6 years [b]	147	1.72	0.805			
	7 to 9 years [c]	46	1.65	0.594			
	>10 years [d]	41	1.38	0.282			

*p< .05, **p< .01, ***p< .001; M, mean; SD, standard deviation; Superscripts ([a, b, c, d]) denote significant group differences based on post-hoc analysis; NA, not applicable.

Females reported higher depressive symptoms than males (t = -3.385, p = 0.001). Age groups also showed significant differences (F = 15.604, p = 0.001), with individuals aged 30–49 reporting higher symptoms than those aged 20–29 or 50–59.

Occupational status influenced depressive symptoms (F = 10.084, p = 0.001), with unemployed individuals reporting higher symptoms than students and office workers. Marital status was significant, as married individuals reported higher symptoms than singles (t = 2.312, p = 0.022).

Monthly income was associated with depressive symptoms (F = 7.599, p = 0.001). Those earning less than $1,500 reported higher symptoms compared to higher income groups. Pet ownership experience also mattered, as first-time pet owners reported higher symptoms (t = 2.866, p = 0.005). Additionally, individuals with younger pets (<3 years) or shorter ownership durations (<3 years) reported higher symptoms (F = 15.352, p = 0.001).

In summary, gender, age, occupation, marital status, income, and pet-related factors significantly influence depressive symptoms, emphasizing the need for targeted mental health interventions.

3.5.2. Association Between Demographic Variables and Pet Attachment

The findings demonstrate notable variations in subjective well-being based on demographic factors. (Table 6)

Table 6. Differences in Pet Attachment by Demographic Characteristics.

Outcome Variable		*N*	*M*	*SD*	*t/F*	*p*	*Post-hoc*
Gender	Male	137	4.13	0.529	-4.183***	.001	
	Female	254	4.36	0.492			
Age Group	20 to 29 years old [a]	122	4.35	0.476	3.001*	.034	*a>c*
	30 to 39 years old [b]	187	4.28	0.51			
	40 to 49 years old [c]	57	4.08	0.63			
	50 to 59 years old [d]	25	4.33	0.354			
Education Level	Up to high school [a]	62	4.09	0.672	3.526*	.022	*c>a*
	College [b]	80	4.21	0.543			
	Undergraduate degree [c]	239	4.34	0.454			

 doi:10.20944/preprints202509.0143.v1

	Graduate degree [d]	10	4.34	0.238			
Income Status	Income	58	4.06	0.856	-2.230*	.029	
	No Income	333	4.31	0.422			
Monthly Income	Less than $1,500 [a]	41	3.89	0.934	4.289**	.007	*b>a*
	$1,500 and $2,000 [b]	145	4.37	0.33			
	$2,000 and $3,000 [c]	153	4.28	0.461			
	Over $ 3,000 [d]	52	4.31	0.517			
Pet Age	< 3 years old [a]	171	4.36	0.42	3.008*	.036	*b>a*
	4 to 6 years old [b]	51	4.27	0.409			
	7 to 9 years old [c]	18	4.33	0.409			
	>10 years old [d]	137	4.13	0.529			

*p< .05, **p< .01, ***p< .001; M, mean; SD, standard deviation; Superscripts ([a, b, c, d]) denote significant group differences based on post-hoc analysis; NA, not applicable.

Females reported higher attachment than males (t = −4.183, p = .001). Age groups showed differences (F = 3.001, p = .034), with individuals aged 20–29 reporting higher attachment than those aged 40–49.

Education level was significant (F=3.526, p=0.022), as undergraduate degree holders showed higher attachment than those with a high school education. Income status (t = −2.230, p = .029) and monthly income (F = 4.289, p = .007) influenced attachment, with those earning $1,500–$2,000 showing higher attachment than lower-income groups.

Pet age also mattered (F = 3.008, p = .036), as individuals with pets under three years old reported higher attachment than those with pets aged 7–9 years.

In summary, gender, age, education, income, and pet-related factors significantly influence pet attachment.

3.5.3. Association Between Demographic Variables and Human-Animal Bond

Significant disparities in subjective well-being were observed across demographic categories. (Table 7)

Table 7. Differences in Human-Animal Bond by Demographic Characteristics.

Outcome Variable		*N*	*M*	*SD*	*t/F*	*p*	*Post-hoc*
Gender	Male	137	4.15	0.58	-3.385***	.001	
	Female	254	4.35	0.502			
Age Group	20 to 29 years old [a]	122	4.38	0.478	4.552**	.005	*b>a*
	30 to 39 years old [b]	187	4.31	0.497			
	40 to 49 years old [c]	57	4.04	0.687			
	50 to 59 years old [d]	25	4.13	0.567			
Education Level	Up to high school [a]	19	4.01	0.702	4.639**	.007	*c>a*
	College [b]	266	4.28	0.551			
	Undergraduate degree [c]	67	4.35	0.462			
	Graduate degree [d]	39	4.16	0.51			
Marital Status	Married	121	4.14	0.604	-3.148**	.002	
	Single(non-marital)	270	4.34	0.495			

 doi:10.20944/preprints202509.0143.v1

Monthly Income	Less than $1,500 [a]	41	4.03	0.888	3.818*	.012	*NS.*
	$1,500 and $2,000 [b]	145	4.38	0.372			
	$2,000 and $3,000 [c]	153	4.27	0.499			
	Over $ 3,000 [d]	52	4.22	0.616			
Pet ownership Experience	First	295	4.25	0.54	-2.079*	.038	
	Second over	96	4.38	0.525			
Pet Age	< 3 years old [a]	151	4.16	0.63	3.804*	.014	*b>a*
	4 to 6 years old [b]	171	4.37	0.453			
	7 to 9 years old [c]	51	4.3	0.478			
	>10 years old [d]	18	4.32	0.466			
Duration of Pet Ownership	< 3 years [a]	157	4.17	0.619	3.986**	.009	*b>a*
	4 to 6 years [b]	147	4.38	0.46			
	7 to 9 years [c]	46	4.27	0.522			
	>10 years [d]	41	4.36	0.405			

*p< .05, **p< .01, ***p< .001; M, mean; SD, standard deviation; Superscripts ([a, b, c, d]) denote significant group differences based on post-hoc analysis; NA, not applicable.

Females reported significantly higher levels of human-animal bond than males (t = -3.385, p = .001). Age differences were significant (F = 4.552, p = .005), with individuals aged 20–29 years reporting higher bond scores than those in older age groups. Educational attainment also showed a significant effect (F = 4.639, p = .007); participants with undergraduate degrees reported higher bond scores compared to those with lower education levels. Marital status was significant, with single individuals reporting higher levels of human-animal bond than married individuals (t = -3.148, p = .002). Monthly income differences were observed (F = 3.818, p = .012), with those earning $1,500–$2,000 per month reporting higher bond scores than other income groups.

Pet ownership experience was significant, as individuals with experience owning more than one pet reported higher bond scores than first-time owners (t = -2.079, p = .038). Pet age also influenced the human-animal bond (F = 3.804, p = .014), with those whose pets were 4 to 6 years old reporting higher bond scores than those with younger pets. Similarly, the duration of pet ownership was significant (F = 3.986, p = .009), with individuals who had owned their pets for 4 to 6 years reporting higher bond scores than those with shorter durations. These findings highlight the importance of both demographic and pet-related factors in shaping the strength of the human-animal bond.

3.5.4. Association Between Demographic Variables and Subjective Well-Being

The results in Table 8 reveal significant differences in subjective well-being across various demographic and contextual factors. (Table 8)

Table 8. Differences in Subjective Well-Being by Demographic Characteristics.

Outcome Variable		*N*	*M*	*SD*	*t/F*	*p*	*Post-hoc*
Gender	Male	137	4.12	0.649	-3.593***	.001	
	Female	254	4.34	0.494			
Age Group	20 to 29 years old [a]	122	4.42	0.496	6.355***	.001	*a>c*
	30 to 39 years old [b]	187	4.24	0.589			
	40 to 49 years old [c]	57	4.04	0.617			
	50 to 59 years old [d]	25	4.24	0.301			

 doi:10.20944/preprints202509.0143.v1

Occupation	Student [a]	19	4.37	0.308	3.749*	.015	*a>d*
	Office Worker [b]	266	4.3	0.518			
	Self-employment [c]	67	4.35	0.298			
	Other(unemployed) [d]	39	3.83	0.983			
Income Status	Income	58	4.01	0.86	-2.570*	.013	
	No Income	333	4.31	0.482			
Marital Status	Married	121	4.17	0.499	-2.320*	.021	
	Single(non-marital)	270	4.31	0.585			
Monthly Income	Less than $1,500 [a]	41	3.92	1.003	7.652**	.001	*b>a*
	$1,500 and $2,000 [b]	145	4.41	0.305			
	$2,000 and $3,000 [c]	153	4.24	0.551			
	Over $ 3,000 [d]	52	4.19	0.553			
Pet ownership Experience	First	295	4.22	0.598	-3.423**	.001	
	Second over	96	4.4	0.409			
Pet Age	< 3 years old [a]	151	4.14	0.696	5.807**	.001	*d>a*
	4 to 6 years old [b]	171	4.38	0.445			
	7 to 9 years old [c]	51	4.22	0.47			
	>10 years old [d]	18	4.41	0.277			
Duration of Pet Ownership	< 3 years [a]	157	4.14	0.685	7.300**	.001	*d>a*
	4 to 6 years [b]	147	4.35	0.459			
	7 to 9 years [c]	46	4.22	0.477			
	>10 years [d]	41	4.46	0.32			

*p< .05, **p< .01, ***p< .001; M, mean; SD, standard deviation; Superscripts ([a, b, c, d]) denote significant group differences based on post-hoc analysis; NA, not applicable.

Gender differences were evident, with females reporting significantly higher well-being scores compared to males ($t = -3.593$, $p < .001$). Age also played a significant role ($F = 6.355$, $p < .001$), where individuals aged 20–29 years exhibited the highest well-being, followed by a gradual decline in older age groups.

Occupational status influenced well-being ($F = 3.749$, $p = .015$), with self-employed individuals scoring higher than students and unemployed individuals. Marital status was also significant, with single individuals reporting higher well-being compared to married individuals ($t = -2.320$, $p = .021$). Income level showed notable differences ($F = 7.652$, $p < .001$), where those earning $1,500–$2,000 reported the highest well-being.

Pet ownership experience and pet-related factors significantly impacted well-being. Second-time pet owners reported higher well-being compared to first-time owners ($t = -3.423$, $p < .001$). Pet age ($F = 5.807$, $p < .001$) and ownership duration ($F = 7.300$, $p < .001$) also contributed, with older pets (4–6 years) and longer ownership durations (>10 years) associated with higher scores. These findings underscore the multifaceted nature of subjective well-being and its associations with demographic and contextual variables.

3.6. Analysis of Relationships Among Key Variables

3.6.1. Relationship Between Depressive Symptoms and Pet Attachment

Table 9 presents the results of a simple linear regression analysis examining the effect of depressive symptoms on pet attachment. (Table 9).

 doi:10.20944/preprints202509.0143.v1

Table 9. Simple Linear Regression Analysis of the Effect of Depressive Symptoms on Pet Attachment.

Variable	B	SE	*β*	*t (p)*	*F (p)*	R^2
(Constant)	4.905	0.050		98.841***	197.887***	0.211
Depressive Symptoms	-0.358	0.025	-0.581	-14.067***		

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

The regression model reveals a statistically significant relationship between depressive symptoms and pet attachment, supported by the F-statistic (F = 197.887, p < .001).

The unstandardized coefficient (B = −0.358, SE = 0.025) indicates that a one-unit increase in depressive symptoms is associated with a 0.358-unit decrease in pet attachment. The standardized coefficient (β = −0.581) demonstrates a strong negative relationship between the two variables. Furthermore, the t-value (t = −14.067, p< .001) confirms the statistical significance of depressive symptoms as a predictor variable. The coefficient of determination (R^2 = 0.211) indicates that 21.1% of the variance in pet attachment is explained by depressive symptoms.

3.6.2. Relationship Between Depressive Symptoms and Subjective Well-Being

Table 10 presents the results of a simple linear regression analysis examining the effect of depressive symptoms on subjective well-being. (Table 10)

Table 10. Simple Linear Regression Analysis of the Effect of Depressive Symptoms on Pet Attachment.

Variable	B	SE	*β*	*t (p)*	*F (p)*	R^2
(Constant)	4.997	0.052		95.750***	241.964***	0.382
Depressive Symptoms	-0.417	0.027	-0.619	-15.555***		

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

The regression model indicates a statistically significant relationship, as evidenced by the F-statistic (F = 241.964, p < .001).

The unstandardized coefficient (B = −0.417, SE = 0.027) suggests that a one-unit increase in depressive symptoms is associated with a 0.417-unit decrease in subjective well-being. The standardized coefficient (β = −0.619) demonstrates a strong negative relationship between depressive symptoms and subjective well-being. The t-value (t = −15.555, p < .001) confirms the statistical significance of the predictor variable. The coefficient of determination (R^2 = 0.382) indicates that 38.2% of the variance in subjective well-being is explained by depressive symptoms.

3.6.3. Multiple Linear Regression Analysis of the Effects of Depressive Symptoms, Pet Attachment, and Human-Animal Bond on Subjective Well-Being

Table 11 presents the results of a multiple linear regression analysis examining the effects of depressive symptoms, pet attachment, and the human-animal bond on subjective well-being, controlling for demographic and pet-related factors. (Table 11)

Table 11. Multiple Linear Regression Analysis of the Effects of Depressive Symptoms, Pet Attachment, and Human-Animal Bond on Subjective Well-Being.

Variable	*B*	*SE*	*β*	*t*	*p*	*TOL*	*VIF*
(Constant)	1.389	0.258		5.393***	.000		
Depressive Symptoms	0.356	0.048	0.340	7.363***	.000	0.373	2.681
Pet Attachment	-0.158	0.025	-0.234	-6.246***	.000	0.566	1.767
Human-Animal Bond	0.372	0.057	0.341	6.556***	.000	0.294	3.399

 doi:10.20944/preprints202509.0143.v1

Gender	0.037	0.037	0.032	1.000	.318	0.793	1.261
Age Group	-0.031	0.027	-0.047	-1.146	.252	0.470	2.126
Education Level	-0.059	0.023	-0.082	-2.511*	.012	0.750	1.334
Occupation	-0.053	0.027	-0.068	-1.957	.051	0.654	1.529
Income Status	0.202	0.059	0.127	3.402**	.001	0.567	1.765
Marital Status	-0.073	0.047	-0.060	-1.547	.123	0.535	1.869
Monthly Income	-0.030	0.025	-0.045	-1.225	.221	0.578	1.730
Pet Ownership Experience	0.038	0.052	0.029	0.732	.464	0.511	1.958
Pet Age	0.071	0.060	0.042	1.183	.237	0.643	1.556
Duration of Pet Ownership	-0.041	0.038	-0.060	-1.072	.284	0.258	3.882
F(p)	62.193***						
adj.R^2	0.690						
Durbin-Watson	1.867						

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

The results indicated that depressive symptoms were significantly associated with lower subjective well-being (β = 0.340, p < .001). Pet attachment demonstrated a significant negative relationship with subjective well-being (B = −0.158, β = −0.234, p < .001), whereas the human-animal bond exhibited a significant positive effect (B = 0.372, β = 0.341, p < .001).

Among demographic variables, only education level (B = −0.059, β = −0.082, p = .012) and income status (B = 0.202, β = 0.127, p = .001) emerged as significant predictors of subjective well-being. Other demographic factors, including gender, age group, occupation, marital status, and monthly income, were not significantly associated with subjective well-being (all p > .05).

None of the pet-related factors—pet ownership experience, pet age, or duration of pet ownership—showed significant effects on subjective well-being (all p > .05).

The model accounted for 69.0% of the variance in subjective well-being (adjusted R^2 = 0.690), with no evidence of multicollinearity or autocorrelation (Durbin–Watson = 1.867). Collectively, these findings underscore the critical roles of depressive symptoms, pet attachment, and the human-animal bond in shaping subjective well-being.

3.7. Examining the Mediating Role of Pet Attachment in the Relationship Between Depressive Symptoms and Subjective Well-Being

This analysis investigated the impact of depressive symptoms on subjective well-being, with pet attachment serving as a mediator, while controlling for education level and income status.)

3.7.1. Sequential Mediation Analysis of Pet Attachment in the Link Between Depressive Symptoms and Subjective Well-Being

The results of the mediation analysis are summarized in Table 12.

Table 12. Mediation Analysis of the Effect of Depressive Symptoms on Subjective Well-Being through Pet Attachment.

Model	Independent variable	Dependent Variable	*B*	*SE*	*t*	*95% CI*	
						LLCI	*ULCI*
1	Depressive Symptoms	Pet Attachment	-0.370	0.024	-15.200***	-0.418	-0.322
	Education Level		0.129	0.028	4.625***	0.074	0.184

 doi:10.20944/preprints202509.0143.v1

	Income Status		0.157	0.062	2.543*	0.035	0.278
	*F= 87.179***, R^2= 0.403*						
2	Depressive Symptoms	Subjective Well-Being	-0.182	0.026	-6.947***	-0.234	-0.131
	Pet Attachment		0.647	0.043	14.928***	0.562	0.733
	Education Level		-0.035	0.024	-1.445	-0.084	0.013
	Income Status		0.166	0.053	3.135**	0.062	0.270
	*F= 168.274***, R^2= 0.636*						
3	Depressive Symptoms	Subjective Well-Being	-0.422	0.026	-16.195***	-0.473	-0.371
	Education Level		0.048	0.030	1.614	-0.011	0.107
	Income Status		0.267	0.066	4.058***	0.138	0.397
	*F= 95.395***, R^2= 0.425*						

*p< .05, **p< .01, ***p< .001; † LLCI: the lower bound within the 95% confidence interval of the bootstrap indirect effect; ‡ ULCI: the upper bound within the 95% confidence interval of the bootstrap indirect effect.; The results are presented in unstandardized coefficients.

Model 1: Depressive Symptoms and Pet Attachment

The results of Model 1 indicate that depressive symptoms significantly and negatively predict pet attachment (B = −0.370, SE = 0.024, t = −15.200, p < .001), suggesting that individuals with high-er levels of depressive symptoms tend to exhibit lower levels of attachment to their pets. Among the control variables, education level was found to have a significant positive association with pet attachment (B = 0.129, p < .001), indicating that individuals with higher educational attainment are more likely to report stronger attachment to their pets. Similarly, income status was positively as-sociated with pet attachment (B = 0.157, p < .05), implying that individuals with higher income levels also tend to develop stronger bonds with their pets.

Model 2: Pet Attachment and Subjective Well-Being

In Model 2, pet attachment emerged as a significant positive predictor of subjective well-being (B = 0.647, SE = 0.043, t = 14.928, p < .001), indicating that individuals who report stronger attachment to their pets tend to experience higher levels of subjective well-being. Among the control variables, income status was also found to significantly and positively predict subjective well-being (B = 0.166, p < .01), suggesting that individuals with higher income levels report greater subjective well-being. However, education level did not exhibit a significant effect on subjective well-being (B = −0.035, p > .05).

Model 3: Depressive Symptoms and Subjective Well-Being

The results from Model 3 demonstrate that depressive symptoms have a significant and negative direct effect on subjective well-being (B = −0.422, SE = 0.026, t = −16.195, p < .001), indicating that higher levels of depressive symptoms are directly associated with lower levels of subjective well-being. Regarding the control variables, education level did not significantly predict subjective well-being (B = 0.048, p > .05), while income status showed a significant positive effect (B = 0.267, p < .001). This finding suggests that individuals with higher income levels are more likely to report greater subjective well-being, even when controlling for depressive symptoms.

Notably, despite the significant effects of the control variables, the mediating effect of pet attachment remained significant.

3.7.2. Direct, Mediating, and Moderating Effects Between Depressive Symptoms, Pet Attachment, and Subjective Well-Being

This analysis investigates the mediating role of pet attachment in the relationship between depressive symptoms and subjective well-being. (Table 13)

Table 13. Mediation Analysis Results for the Effect of Depressive Symptoms on Subjective Well-Being.

 doi:10.20944/preprints202509.0143.v1

Category	*Effect*	*Boot S.E.*	*95% CI*	
			Boot LLCI	*Boot ULCI*
Total effect(t)	-0.422	0.026	-0.473	-0.371
Direct Effect (c)	-0.182	0.026	-0.234	-0.131
Indirect Effect (a×b)	-0.240	0.040	-0.310	-0.170

† LLCI: Lower bound of the 95% confidence interval for the bootstrap indirect effect; ‡ULCI: Upper bound of the 95% confidence interval for the bootstrap indirect effect.; Boot S.E, Bootstrap Standard Error

The results of the mediation analysis revealed that depressive symptoms had a significant total effect on subjective well-being (B = −0.422, 95% CI [−0.473, −0.371]), indicating that higher levels of depressive symptoms are associated with lower levels of subjective well-being. The direct effect of depressive symptoms on subjective well-being was also significant (B = −0.182, 95% CI [−0.234, −0.131]), demonstrating that depressive symptoms negatively influence subjective well-being independently of pet attachment.

Furthermore, the indirect effect of depressive symptoms on subjective well-being, mediated through pet attachment, was significant (B = −0.240, 95% CI [−0.310, −0.170]). The absence of zero within the confidence interval confirms the statistical significance of the mediation effect.

A schematic diagram illustrating the sequential mediation model, with depressive symptoms acting as a mediator between the human-animal bond and subjective well-being, is presented in Figure 2.

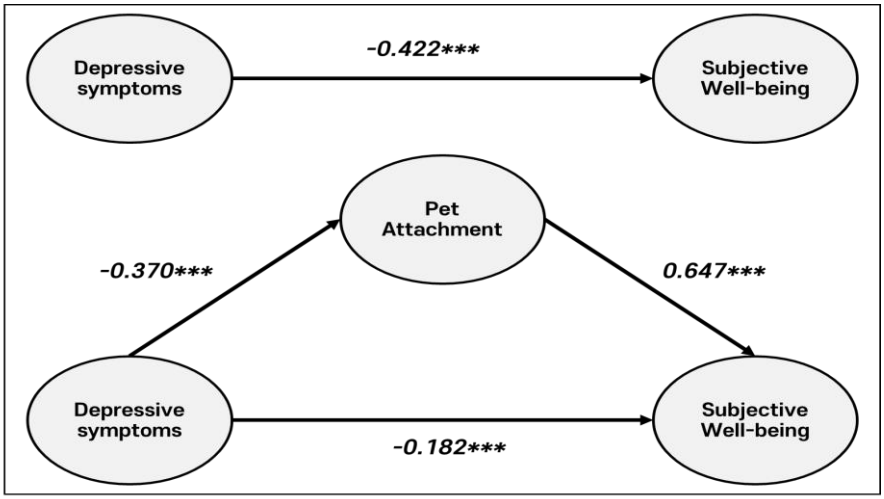


Figure 2. Sequential Mediation Model of the Effect of Pet Attachment in the Relationship Between Depressive Symptoms and Subjective Well-Being.

3.8. Moderation Analysis of the Effect of Human-Animal Bond on the Relationship Between Depressive Symptoms and Subjective Well-Being

Educational attainment and income status, identified as significant predictors in prior analyses, were included as control variables to account for potential confounding effects.

The results presented in Table 14 demonstrate the moderating effect of the human-animal bond on the relationship between depressive symptoms and subjective well-being. (Table 14)

Table 14. Moderating Effect of Human-Animal Bond on the Relationship Between Depressive Symptoms and Subjective Well-Being.

Variable	*B*	*SE*	*t*	*p*

 doi:10.20944/preprints202509.0143.v1

Depressive Symptoms	-0.203	0.023	-8.935***	.000
Human-Animal Bond	0.462	0.039	11.927***	.000
Depressive Symptoms x Human-Animal Bond	0.214	0.031	6.970***	.000
Education Level	-0.009	0.023	-0.397	.691
Income Status	0.163	0.049	3.310**	.001
F			1,710.881***	
R^2			0.691	
ΔR^2			0.039 *(F = 48.585, p = .000)*	

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

Depressive symptoms (B = −0.203, SE = 0.023, t = −8.935, p < .001) were significantly and negatively associated with subjective well-being. In contrast, the human-animal bond (B = 0.462, SE = 0.039, t = 11.927, p < .001) exhibited a significant positive association. Importantly, a significant interaction effect between depressive symptoms and the human-animal bond (B = 0.214, SE = 0.031, t = 6.970, p < .001) was identified, indicating that the human-animal bond moderates the negative impact of depressive symptoms on subjective well-being. Specifically, a stronger human-animal bond mitigates the adverse effects of depressive symptoms on subjective well-being.

Among the control variables, income status (B = 0.163, SE = 0.049, t = 3.310, p = .001) was a significant positive predictor of subjective well-being, whereas education level (B = −0.009, SE = 0.023, t = −0.397, p = .691) did not exhibit a significant effect.

The overall regression model was highly significant (F = 1,710.881, p < .001) and explained 69.1% of the variance in subjective well-being (R^2 = 0.691). In addition, the inclusion of the interaction term significantly increased the explanatory power (ΔR^2 = 0.039, F = 48.585, p < .001). These findings underscore the critical role of the human-animal bond in mitigating the negative effects of depressive symptoms and enhancing subjective well-being.

The moderating effect of the human-animal bond on the relationship between depressive symptoms and subjective well-being is visually depicted in Figure 3.

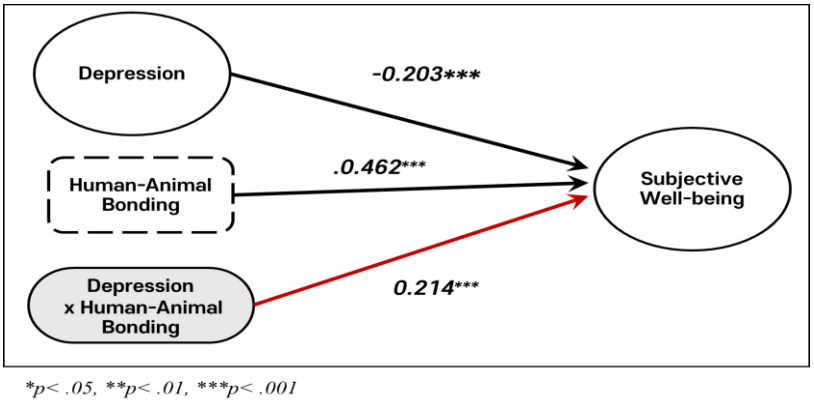


Figure 3. Moderating Effect of Human-Animal Bond on the Relationship Between Depressive Symptoms and Subjective Well-Being.

3.8.1. Conditional Moderation Analysis of the Human-Animal Bond on the Relationship Between Depressive Symptoms and Subjective Well-Being

This study examined the conditional moderating effect of the human-animal bond on the relationship between depressive symptoms and subjective well-being. For this analysis, the human-animal bond was categorized into three levels: low (-1 SD), medium (mean), and high (+1 SD). The

 doi:10.20944/preprints202509.0143.v1

results, presented in Table 15, revealed that the negative effect of depressive symptoms on subjective well-being varied depending on the level of the human-animal bond. (Table 15)

Table 15. Conditional Moderating Effect of Human-Animal Bond on the Relationship Between Depressive Symptoms and Subjective Well-Being.

Variable	*B*	*SE*	*t*	*p*
-.538(-1SD)	-0.318	0.025	-12.947***	.000
.000(Mean)	-0.203	0.023	-8.935***	.000
.538(+1SD)	-0.087	0.031	-2.805**	.005

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

At the low level of the human-animal bond (-1 SD), depressive symptoms had a strong negative effect on subjective well-being (B = −0.318, SE = 0.025, t = −12.947, p < .001). At the medium level (mean), the negative effect was reduced but remained significant (B = −0.203, SE = 0.023, t = −8.935, p < .001). At the high level (+1 SD), the effect was further attenuated but still statistically significant (B = −0.087, SE = 0.031, t = −2.805, p = .005).

These findings underscore the moderating role of the human-animal bond in the relationship between depressive symptoms and subjective well-being. Specifically, higher levels of the bond mitigate the negative effects of depressive symptoms, highlighting its protective function in reducing adverse psychological outcomes.

To further explore this interaction, a simple slope analysis and the Johnson-Neyman technique were conducted[59]. The Johnson-Neyman method identified specific thresholds of the human-animal bond where its moderating effect became significant, providing deeper insights into the interaction effects[60,61].

Figure 4 illustrates the conditional moderating effect of the human-animal bond on the relationship between depressive symptoms and subjective well-being.

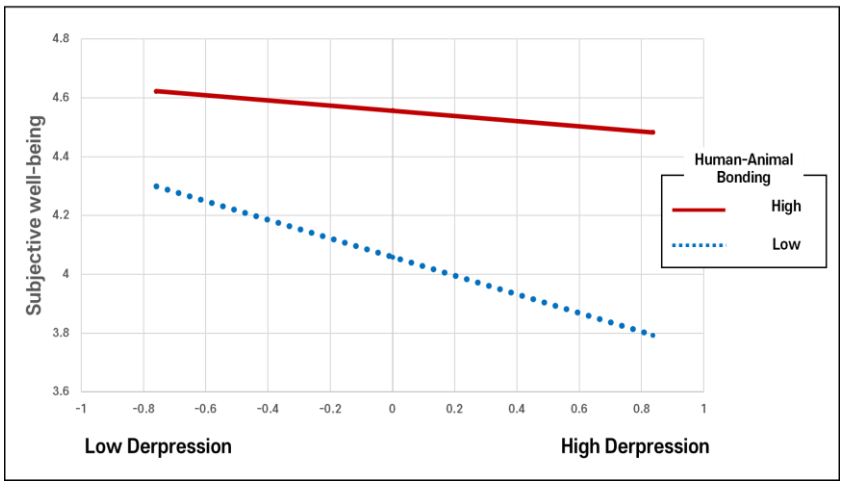


Figure 4. Simple Slope Analysis of the Moderating Effect of Human-Animal Bond on the Relationship Between Depressive Symptoms and Subjective Well-Being.

The analysis differentiates between individuals with high levels of human-animal bonding (solid red line) and those with low levels (dotted blue line).

The steep downward slope of the dotted blue line indicates a strong negative association between depressive symptoms and subjective well-being for individuals with low human-animal bonding. This suggests that as depressive symptoms increase, subjective well-being declines significantly in this group.

 doi:10.20944/preprints202509.0143.v1

In contrast, the relatively flat slope of the solid red line demonstrates that the negative association between depressive symptoms and subjective well-being is considerably attenuated for individuals with high levels of human-animal bonding. This implies that individuals with stronger human-animal bonds experience less of a decline in subjective well-being, even when facing similar levels of depressive symptoms.

These findings underscore the role of human-animal bonds as a protective moderator, mitigating the adverse effects of depressive symptoms on subjective well-being.

3.8.2. The Moderating Role of the Human-Animal Bond in the Relationship Between Depressive Symptoms and Subjective Well-Being: A Johnson-Neyman Analysis

The Johnson-Neyman technique was employed to identify the critical threshold at which the human-animal bond significantly moderates the relationship between depressive symptoms and subjective well-being. The analysis revealed a critical value of 0.640 for the human-animal bond, beyond which the moderating effect becomes statistically significant. (Table 16)

Table 16. Johnson-Neyman Analysis of Human-Animal Bond on the Relationship Between Depressive Symptoms and Subjective Well-Being.

Human-Animal Bond Level	*Percentage (%)*
% below	98.465%
% above	1.535%
Critical Value	0.640

Critical Value, Threshold.

The results indicated that 98.465% of the sample scored below this threshold, suggesting that for the vast majority of participants, the human-animal bond did not significantly buffer the negative association between depressive symptoms and subjective well-being. Conversely, only 1.535% of the sample scored above the critical threshold, indicating a notable and statistically significant moderating effect.

3.9. Moderated Mediation of Depressive Symptoms and Pet Attachment: Results from Model 8

3.9.1. Moderated Mediation Analysis: The Moderating Role of Human-Animal Bonding in the Effect of Depressive Symptoms on Pet Attachment

In Model 8, the relationship between depressive symptoms (independent variable) and pet attachment (mediator) was analyzed to assess whether it is moderated by the human-animal bond (moderator). Education level and income status were included as control variables in the analysis. The results of this analysis are presented in Table 17

Table 17. Moderated Mediation Effect of Human-Animal Bonding on the Relationship Between Depressive Symptoms and Pet Attachment.

Model	Variable	*B*	*SE*	*t*	*95% CI*	
					LLCI	*ULCI*
Mediator Model (Dependent Variable: Pet Attachment)						
1	Depressive Symptoms	-0.155	0.020	-7.703***	-0.195	-0.115
	Human-Animal Bonding	0.484	0.034	14.063***	0.416	0.551
	Depressive Symptoms x Human-Animal Bonding	0.183	0.027	6.728***	0.130	0.237
	Education Level	0.067	0.020	3.276**	0.027	0.107

 doi:10.20944/preprints202509.0143.v1

Income Status	0.061	0.044	1.400	-0.025	0.147
*F= 188.870***					
R^2= .710					
ΔR^2 = 0.034(F=45.262, p= 0.000)					

*p< .05, **p< .01, ***p< .001; † LLCI: the lower bound within the 95% confidence interval of the bootstrap indirect effect; ‡ ULCI: the upper bound within the 95% confidence interval of the bootstrap indirect effect.; The results are presented in unstandardized coefficients.

The findings indicate that depressive symptoms had a significant negative effect on pet attachment (B = -0.155, SE = 0.020, t = -7.703, p < .001), suggesting that higher levels of depressive symptoms are associated with lower levels of attachment to pets. Conversely, the human-animal bond demonstrated a significant positive effect on pet attachment (B = 0.484, SE = 0.034, t = 14.063, p < .001), indicating that stronger human-animal bonding is linked to increased attachment to pets.

Notably, the interaction term between depressive symptoms and the human-animal bond (Depressive Symptoms × Human-Animal Bonding) showed a significant positive effect on pet attachment (B = 0.183, SE = 0.027, t = 6.728, p < .001). This result highlights that the human-animal bond moderates the relationship between depressive symptoms and pet attachment, with a stronger bond mitigating the adverse impact of depressive symptoms on pet attachment.

Additionally, the effects of control variables were examined. Education level had a significant positive effect on pet attachment (B = 0.067, SE = 0.020, t = 3.276, p < .001), whereas income status did not exhibit a statistically significant effect (B = 0.061, SE = 0.044, t = 1.400, p > .05).

The overall regression model was highly significant (F = 188.870, p < .001) and explained 71.0% of the variance in pet attachment (R^2 = 0.710). Furthermore, the inclusion of the interaction term resulted in a significant increase in explanatory power (ΔR^2 = 0.034, F = 45.262, p < .001).

The moderated mediation effect of the human-animal bond on the relationship between depressive symptoms and subjective well-being is visually depicted in Figure 5.

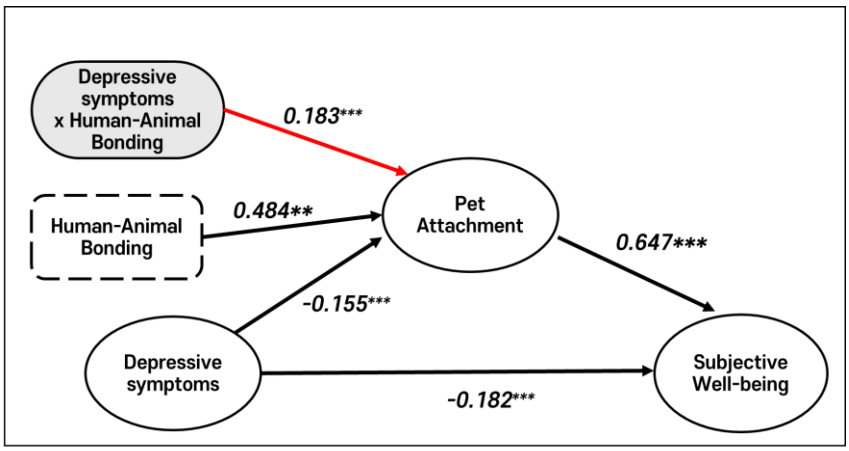


Figure 5. Moderated Mediation Model (PROCESS Model 8): The Role of the Human-Animal Bond in the Relationship Between Depressive Symptoms and Pet Attachment.

3.9.1.1. Conditional Moderation of the Human-Animal Bond in the Relationship Between Depressive Symptoms and Pet Attachment

The conditional moderation analysis examined the direct effect of depressive symptoms on pet attachment, with the human-animal bond serving as a moderator. Specifically, the impact of depressive symptoms was assessed at three levels of the human-animal bond: low (-1 SD), average (mean), and high (+1 SD). (Table 18)

 doi:10.20944/preprints202509.0143.v1

Table 1. The Conditional Direct Effect of Human-Animal Bonding on the Relationship Between Depressive Symptoms and Pet Attachment.

Variable	*B*	*SE*	*t*	*p*
-.538(-1SD)	-0.254	0.022	-11.646	.000
.000(Mean)	-0.155	0.02	-7.703	.000
.538(+1SD)	-0.056	0.028	-2.038	.042

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

The analysis revealed that the negative effect of depressive symptoms on pet attachment diminished as the level of the human-animal bond increased. At a low level of the human-animal bond (-1 SD), depressive symptoms had a strong negative effect on pet attachment (B = -0.254, SE = 0.022, t = -11.646, p < .001), indicating that weaker human-animal bonds exacerbate the detrimental impact of depressive symptoms. At an average level of the human-animal bond (mean), depressive symptoms continued to exert a negative effect on pet attachment (B = -0.155, SE = 0.020, t = -7.703, p < .001), but the strength of this effect was weaker compared to the low level. Finally, at a high level of the human-animal bond (+1 SD), the negative impact of depressive symptoms on pet attachment was further attenuated (B = -0.056, SE = 0.028, t = -2.038, p < .05).

These findings underscore the moderating role of the human-animal bond in mitigating the negative influence of depressive symptoms on pet attachment. Higher levels of the human-animal bond provide greater protection against the decline in pet attachment, highlighting its buffering potential.

3.9.1.2. Visualization of Simple Slope Analysis: The Moderating Effect of Human-Animal Bonding on the Relationship Between Depressive Symptoms and Pet Attachment

Figure 6 visually represents the results of a simple slope analysis, illustrating how the relationship between depressive symptoms and pet attachment varies based on the level of the human-animal bond (high vs. low). The X-axis represents the level of depressive symptoms, while the Y-axis de-notes pet attachment. The red solid line corresponds to a high level of the human-animal bond, whereas the blue dashed line represents a low level of the bond. (Figure 6)

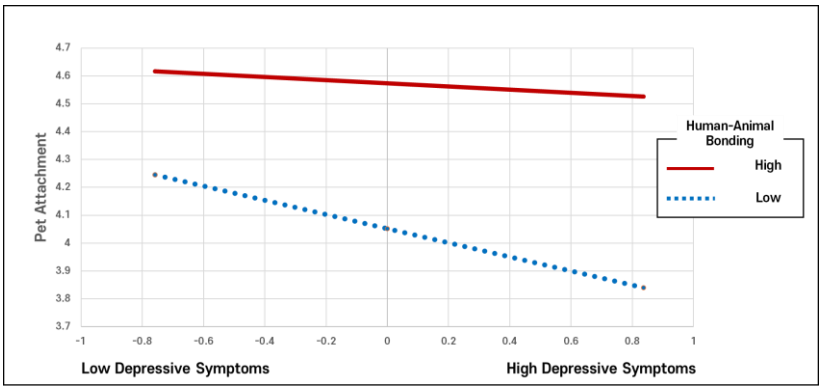


Figure 6. Visualization of the Moderating Effect of Human-Animal Bonding on the Relationship Between Depressive Symptoms and Pet Attachment.

The graph demonstrates that when the human-animal bond is high (red solid line), pet attachment remains relatively stable even as depressive symptoms increase. In contrast, when the human-animal bond is low (blue dashed line), pet attachment declines sharply with increasing depressive symptoms. These findings suggest that a strong human-animal bond serves as a protective factor, buffering the negative impact of depressive symptoms on pet attachment.

Overall, the visualization highlights the moderating role of the human-animal bond, with higher levels of bonding mitigating the adverse effects of depressive symptoms. This supports the

 doi:10.20944/preprints202509.0143.v1

conclusion that the human-animal bond may function as a potential protective factor against the decline in pet attachment associated with depressive symptoms.

3.9.1.3. Threshold Analysis of Human-Animal Bonding Level in Moderating the Effect of Depressive Symptoms on Pet Attachment

To enhance analytical rigor, the Johnson-Neyman technique was applied to identify the threshold at which Human-Animal Bonding significantly moderates the relationship between depressive symptoms and pet attachment. (Table 19)

Table 19. Threshold Analysis of Pet Attachment Level in Moderating the Effect of Depressive Symptoms Pet Attachment.

Human-Animal Bonding Level	*Percentage(%)*
% below	92.327%
% above	7.673%
Critical Value	0.547

Critical Value, Threshold.

As presented in Table 19, 92.327% of the sample falls below the critical value of 0.547 for pet attachment, while only 7.673% exceeds this threshold. When Human-Animal Bonding surpasses 0.547, its moderating effect on the relationship between depressive symptoms and pet attachment becomes statistically significant. Specifically, Human-Animal Bonding above this threshold effectively buffers the negative impact of depressive symptoms on pet attachment.

3.9.2. Moderated Mediation Analysis: The Role of Human-Animal Bonding in the Indirect Effect of Depressive Symptoms on Subjective Well-Being Through Pet Attachment

This study examined whether human-animal bonding moderates the indirect effect of depressive symptoms (independent variable) on subjective well-being (dependent variable) through pet attachment. The results of the moderated mediation analysis are summarized in (Table 20).

Table 2. Moderated Mediation Analysis of the Effect of Human-Animal Bonding on the Relationship Between Depressive Symptoms and Subjective Well-Being.

Model	Variable	*B*	*SE*	*t*	*95% CI*	
					LLCI	*ULCI*
Dependent Model (Dependent Variable: Subjective Well-Being)						
1	Depressive Symptoms	-0.162	0.024	-6.835***	-0.209	-0.116
	Pet Attachment	0.261	0.056	4.658***	0.151	0.371
	Human-Animal Bonding	0.336	0.046	7.238***	0.245	0.428
	Depressive Symptoms x Human-Animal Bonding	0.166	0.032	5.258***	0.104	0.228
	Education Level	-0.027	0.023	-1.169	-0.071	0.018
	Income Status	0.147	0.048	3.058*	0.053	0.242
*F= 154.548***						
R^2= .707						

 doi:10.20944/preprints202509.0143.v1

$\Delta R^2 = 0.021 (F=27.644, p= 0.000)$

*p< .05, **p< .01, ***p< .001; † LLCI: the lower bound within the 95% confidence interval of the bootstrap indirect effect; ‡ ULCI: the upper bound within the 95% confidence interval of the bootstrap indirect effect.; The results are presented in unstandardized coefficients.

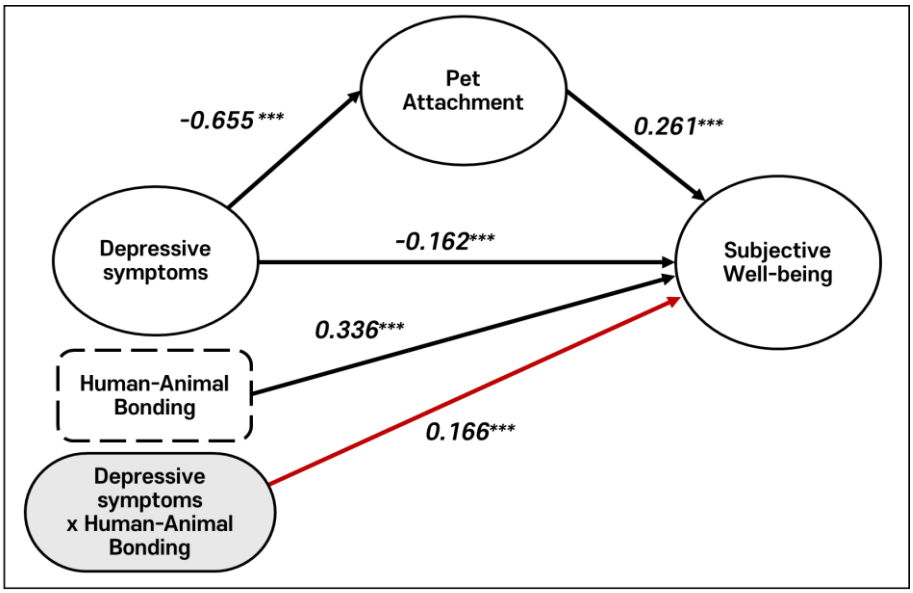
Depressive symptoms had a significant negative effect on subjective well-being (B = -0.162, p < 0.001), indicating that higher depressive symptoms are associated with lower subjective well-being. Pet attachment positively influenced subjective well-being (B = 0.261, p < 0.001), suggesting that stronger attachment to pets enhances subjective well-being. Similarly, human-animal bonding demonstrated a positive effect on subjective well-being (B = 0.336, p < 0.001), underscoring its critical role in promoting well-being.

The interaction term (Depressive Symptoms x Human-Animal Bonding) also showed a significant effect on subjective well-being (B = 0.166, p < 0.001). This finding indicates that human-animal bonding moderates the relationship between depressive symptoms and subjective well-being, with stronger bonding buffering the negative impact of depressive symptoms.

Among the control variables, income status had a significant positive effect on subjective well-being (B = 0.147, p < 0.05), while education level did not show a significant effect.

The overall model explained 70.7% of the variance in subjective well-being (R^2 = 0.707). The inclusion of the interaction term increased the model's explanatory power by ΔR^2 = 0.021, which was statistically significant (F = 27.644, p < 0.001). This result highlights the importance of the inter-action term in improving the model's predictive capacity.

In conclusion, human-animal bonding plays a crucial moderating role in the relationship between depressive symptoms and subjective well-being. Additionally, pet attachment and income status were identified as significant predictors of subjective well-being. Figure 7 illustrates the moderated mediation model, highlighting the role of human-animal bonding in this relationship. (Figure 7)



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

Figure 1. Moderated Mediation Model (PROCESS Model 8): The Role of the Human-Animal Bonding in the Indirect Effect of Depressive Symptoms on Subjective Well-Being through Pet Attachment.

3.9.2.1. Conditional Moderation of Human-Animal Bonding in the Indirect Effect of Depressive Symptoms on Subjective Well-Being Through Pet Attachment

 doi:10.20944/preprints202509.0143.v1

The conditional direct effects of depressive symptoms on pet attachment were analyzed using hu-man-animal bonding as a moderating variable. The analysis examined the effects of depressive symptoms at three levels of human-animal bonding: one standard deviation below the mean (-1SD), the mean level (Mean), and one standard deviation above the mean (+1SD). (Table 21)

Table 21. The Conditional Direct Effect of Human-Animal Bonding on the Relationship Between Depressive Symptoms and Subjective Well-Being.

Variable	*B*	*SE*	*t*	*p*
-.538(-1SD)	-0.252	0.028	-9.052	.000
.000(Mean)	-0.162	0.024	-6.835	.000
.538(+1SD)	-0.073	0.031	-2.383	.018

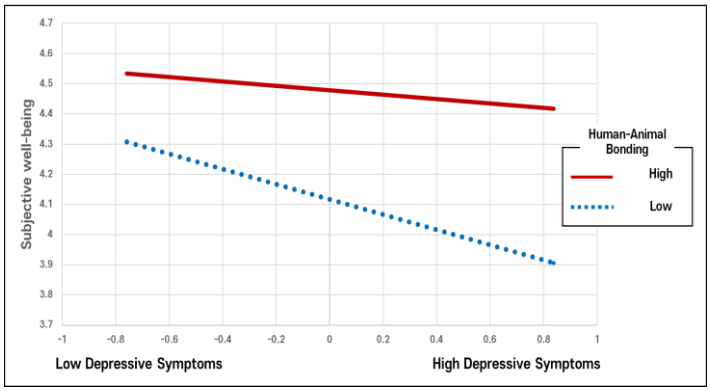
*p< .05, **p< .01, ***p< .001

When human-animal bonding was one standard deviation below the mean (-1SD), the relationship between depressive symptoms and pet attachment was significantly negative and strong (B = -0.254, p < .001). This indicates that lower levels of human-animal bonding exacerbate the negative impact of depressive symptoms, leading to a substantial decrease in pet attachment. At the mean level of human-animal bonding, the relationship remained negative but was less pronounced (B = -0.155, p < .001), suggesting that depressive symptoms still negatively affect pet attachment, though the magnitude of this effect is reduced compared to lower levels of bonding. When human-animal bonding was one standard deviation above the mean (+1SD), the relationship showed the weakest negative effect (B = -0.056, p = .042), demonstrating that higher levels of human-animal bonding significantly attenuate the negative impact of depressive symptoms on pet attachment.

These findings highlight the moderating role of human-animal bonding in the relationship between depressive symptoms and pet attachment. Higher levels of human-animal bonding appear to buffer the adverse effects of depressive symptoms, while lower levels amplify these effects. This underscores the protective function of strong human-animal bonds in mitigating the detrimental impact of depressive symptoms.

3.9.2.2. Visualization of the Moderating Effect of Human-Animal Bonding on the Indirect Effect of Depressive Symptoms on Subjective Well-Being Through Pet Attachment

Figure 8 illustrates the moderating effect of human-animal bonding on the indirect relationship between depressive symptoms and subjective well-being via pet attachment. The X-axis represents the level of depressive symptoms, while the Y-axis denotes subjective well-being. The red solid line corresponds to a high level of human-animal bonding, whereas the blue dashed line represents a low level of bonding. (Figure 8)



 doi:10.20944/preprints202509.0143.v1

Figure 2. Visualization of the Moderating Effect of Human-Animal Bonding in the Indirect Effect of Depressive Symptoms on Subjective Well-Being through Pet Attachment.

The graph demonstrates that when human-animal bonding is low (blue dashed line), increases in depressive symptoms are associated with a steep decline in subjective well-being. This suggests that low levels of human-animal bonding exacerbate the negative impact of depressive symptoms on subjective well-being. In contrast, when human-animal bonding is high (red solid line), the decline in subjective well-being associated with increasing depressive symptoms is more gradual. This indicates that higher levels of human-animal bonding buffer the adverse effects of depressive symptoms on subjective well-being.

Overall, the visualization highlights the moderating role of human-animal bonding, with stronger bonds mitigating the detrimental effects of depressive symptoms on subjective well-being. These findings underscore the importance of the human-animal bond as a potential protective factor that helps preserve subjective well-being in individuals experiencing depressive symptoms.

3.9.2.3. Threshold Analysis of Human-Animal Bonding in the Indirect Effect of Depressive Symptoms on Subjective Well-Being Through Pet Attachment

To enhance analytical precision, the Johnson-Neyman technique was employed to identify the threshold at which Human-Animal Bonding begins to exert a statistically significant moderating effect. (Table 22)

Table 22. Threshold Analysis of Human-Animal Bonding Level in Moderating the Effect of Depressive Symptoms on Subjective Well-Being.

Human-Animal Bonding Level	*Percentage(%)*
% below	98.465%
% above	1.535%
Critical Value	0.600

Critical Value, Threshold.

As presented in Table 22, 98.465% of the sample falls below the critical value of Human-Animal Bonding at 0.600, with only 1.535% exceeding this threshold. This finding indicates that when Human-Animal Bonding surpasses the critical value of 0.600, its moderating effect on the relationship between Depressive Symptoms and Subjective Well-Being becomes significant.

In other words, Human-Animal Bonding above this critical value effectively buffers the negative impact of Depressive Symptoms on Subjective Well-Being. These results highlight the importance of Human-Animal Bonding as a protective factor, particularly for individuals with high levels of depressive symptoms.

3.9.2.4. Conditional Indirect Effects and Moderated Mediation: The Role of Human-Animal Bonding in the Relationship Between Depressive Symptoms, Pet Attachment, and Subjective Well-Being

Table 23 summarizes the results of a conditional analysis examining the indirect effect of depressive symptoms on subjective well-being, moderated by human-animal bonding. Human-animal bonding levels were categorized as low (-1 SD), average (Mean), and high (+1 SD) to evaluate the indirect effect under each condition. (Table 23)

Table 23. Conditional Indirect Effects of Depressive Symptoms on Subjective Well-Being at Varying Levels of Human-Animal Bonding and the Moderated Mediation Index.

Human-Animal Bonding	*Effect*	*Boot SE*	*Boot LLCI*	*Boot ULCI*

 doi:10.20944/preprints202509.0143.v1

-.538(-1SD)	-0.066	0.018	-0.102	-0.033
.000(Mean)	-0.040	0.012	-0.065	-0.019
.538(+1SD)	-0.015	0.009	-0.035	0.002
Moderated Mediation Index	***Index***	***Boot SE***	***Boot LLCI***	***Boot ULCI***
Human-Animal Bonding	0.016	0.026	-0.029	0.074

† LLCI: the lower bound within the 95% confidence interval of the bootstrap indirect effect; ‡ ULCI: the upper bound within the 95% confidence interval of the bootstrap indirect effect.; The results are presented in unstandardized coefficients.

At low levels of human-animal bonding (-1 SD), the indirect effect was -0.066, with a 95% confidence interval (CI) ranging from -0.102 to -0.033, indicating a statistically significant effect. At the average level of human-animal bonding (Mean), the indirect effect was -0.040, with a 95% CI ranging from -0.065 to -0.019, suggesting that a significant indirect effect is also present at the mean level of bonding. However, at high levels of human-animal bonding (+1 SD), the indirect effect decreased to -0.015, with a 95% CI ranging from -0.035 to 0.002, which was not statistically significant.

The moderated mediation index was 0.048, with a 95% CI ranging from 0.022 to 0.078, demonstrating that human-animal bonding significantly moderates the indirect effect of depressive symptoms on subjective well-being. All reported results are based on unstandardized coefficients.

These findings underscore the conditional role of human-animal bonding in the relationship between depressive symptoms and subjective well-being. Specifically, stronger human-animal bonding appears to attenuate the negative indirect effect of depressive symptoms on subjective well-being, while weaker bonding amplifies this effect.

3.9. Dual Moderation in the Mediated Relationship Between Depressive Symptoms and Subjective Well-Being: Results from Model 15

Table 24 presents the results of analyses examining the mediating and moderating effects of the Human-Animal Bond on the relationship between Pet Attachment and Subjective Well-Being. Two distinct models were employed to test specific relationships between the mediator and dependent variables. (Table 24)

Table 24. Mediation and Moderated Mediation Effects of the Human-Animal Bond on the Relationship Between Pet Attachment and Subjective Well-Being: Model 15 Results.

Model	**Variable**	***B***	***SE***	***t***	***95% CI***	
					LLCI	***ULCI***
Mediator Model (Dependent Variable: Pet Attachment)						
1	Depressive Symptoms	-0.370	0.024	-15.200***	-0.418	-0.322
	Education Level	0.129	0.028	4.625***	0.074	0.184
	Income Status	0.157	0.062	2.543*	0.035	0.278
*F= 87.179***, R^2= .403*						
Dependent Model (Dependent Variable: Subjective Well-Being)						
2	Depressive Symptoms	-0.167	0.024	-6.857***	-0.215	-0.119
	Pet Attachment	0.249	0.058	4.329***	0.136	0.362

 doi:10.20944/preprints202509.0143.v1

Human-Animal Bonding	0.330	0.047	6.991***	0.237	0.422
Depressive Symptoms x Human-Animal Bonding	0.133	0.050	2.656*	0.035	0.231
Pet Attachment x Human-Animal Bonding	-0.043	0.051	-0.858	-0.143	0.056
Education Level	-0.029	0.023	-1.250	-0.073	0.016
Income Status	0.141	0.049	2.894**	0.045	0.237
*F= 132.484****					
R^2= 0.708					
Depressive Symptoms x Human-Animal Bonding			*ΔR^2 = 0.005(F=7.055, p= 0.008)*		
Pet Attachment x Human-Animal Bonding			*ΔR^2 = 0.001(F=0.736, p= 0.000)*		

*p< .05, **p< .01, ***p< .001; † LLCI: the lower bound within the 95% confidence interval of the bootstrap indirect effect; ‡ ULCI: the upper bound within the 95% confidence interval of the bootstrap indirect effect.; The results are presented in unstandardized coefficients.

The first model, referred to as the Mediator Model, examined Pet Attachment as the dependent variable. Depressive Symptoms had a significant negative effect on Pet Attachment (B = −0.370, SE = 0.024, t = −15.200, p < .001). Additionally, Education Level (B = 0.129, SE = 0.028, t = 4.625, p < .001) and Income Status (B = 0.157, SE = 0.062, t = 2.543, p < .05) exhibited significant positive effects on Pet Attachment. The model explained 40.3% of the variance in Pet Attachment (R^2 = .403).

The second model, referred to as the Dependent Model, examined Subjective Well-Being as the de-pendent variable. Depressive Symptoms had a significant negative effect on Subjective Well-Being (B = −0.167, SE = 0.024, t = −6.857, p < .001). Both Pet Attachment (B = 0.249, SE = 0.058, t = 4.329, p < .001) and the Human-Animal Bond (B = 0.330, SE = 0.047, t = 6.991, p < .001) had significant positive effects on Subjective Well-Being. Furthermore, the interaction between Depressive Symptoms and the Human-Animal Bond had a significant positive effect on Subjective Well-Being (B = 0.133, SE = 0.050, t = 2.656, p < .05). However, the interaction between Pet Attachment and the Human-Animal Bond was not significant (B = −0.043, SE = 0.051, t = −0.858, p > .05). This model explained 70.8% of the variance in Subjective Well-Being (R^2 = .708).

An evaluation of the increase in explanatory power due to interaction effects revealed that the inter-action between Depressive Symptoms and the Human-Animal Bond provided a significant additional contribution (ΔR^2 = 0.005, F = 7.055, p = .008). In contrast, the interaction between Pet Attachment and the Human-Animal Bond did not yield a significant increase in explanatory power (ΔR^2 = 0.001, F = 0.736, p > .05).

These findings suggest that the Human-Animal Bond moderates the direct effect of Depressive Symptoms on Subjective Well-Being but does not moderate the indirect pathway through Pet Attachment. Consequently, the moderated mediation effect in Model 15 was not significant. Additionally, the index of moderated mediation, as shown in Table 25, was not significant.

The moderating effect of the human-animal bond on the relationships between depressive symptoms, pet attachment, and subjective well-being is visually depicted in Figure 9.

 doi:10.20944/preprints202509.0143.v1

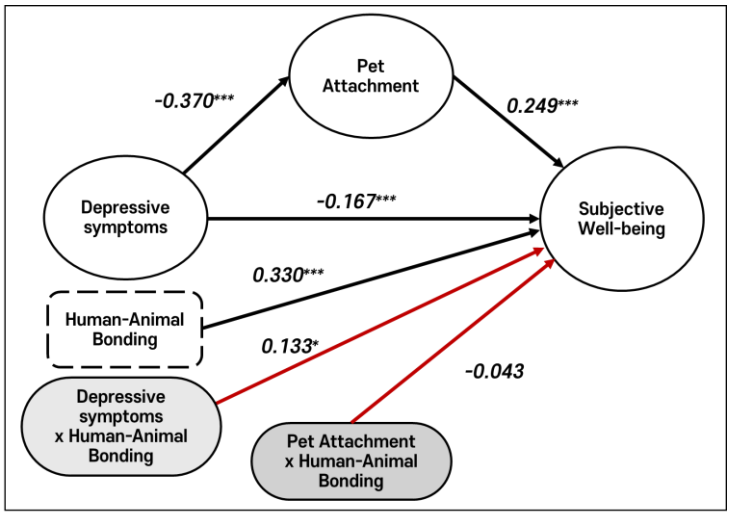


Figure 3. Moderated Mediation Model (PROCESS Model 8): The Role of the Human-Animal Bonding in the Relationship Between Depressive Symptoms, Pet Attachment, and Subjective Well-Being.

4. Discussion

Human-animal bond on subjective well-being, examining their relationships through mediation and moderation effects. The findings provide empirical evidence that relationships with pets can contribute to the enhancement of psychological well-being.

The negative impact of depressive symptoms on subjective well-being was partially mediated by attachment to pets. This result aligns with previous studies indicating that depressive symptoms reduce emotional stability and subjective well-being[62] and that attachment to pets can mitigate these negative effects[63]. Bowlby's attachment theory, originally introduced in 1969, underscores the fundamental role of attachment in promoting emotional stability and psychological well-being[9]. Emotional bonds with pets may serve as a valuable resource by reducing stress, fostering positive emotions, and providing a sense of emotional security[2,64].

The human-animal bond moderated both the direct relationship between depressive symptoms and subjective well-being and the indirect pathway from depressive symptoms through attachment to pets to subjective well-being. Specifically, a stronger human-animal bond attenuated the negative impact of depressive symptoms on subjective well-being, suggesting that the human-animal bond functions as a protective mechanism against psychological stress and emotional challenges[6,65]. These findings are consistent with social support theory[66] and support prior research demonstrating that bonds with pets contribute to emotional stability and well-being[4,5].

While the human-animal bond moderated the direct relationship between depressive symptoms and subjective well-being, its moderating effect was not statistically significant in the indirect pathway involving attachment to pets. This suggests that the human-animal bond may exert a stronger influence on well-being through direct interactions with pets rather than through indirect emotional support[7,67]. These findings highlight the importance of direct interactions with pets, which may provide immediate emotional comfort and alleviate psychological stress.

Although dogs and cats exhibit distinct social behaviors and interaction patterns with humans[13,26,27], no significant differences were observed between dog and cat owners in terms of depression, pet attachment, subjective well-being, or the human-animal bond. This suggests that the psychological benefits of pet ownership may not be species-specific but are instead influenced by the quality of the human-animal relationship. These results align with prior research emphasizing that the strength of the human-animal bond, rather than the type of pet, plays a more critical role in determining psychological outcomes[5,68].

The findings of this study have practical implications for psychological interventions and policy development. Integrating animal-assisted therapy programs into clinical settings may harness the

 doi:10.20944/preprints202509.0143.v1

emotional benefits of human-animal interactions. Public policies could promote pet adoption programs and provide resources to strengthen human-animal bonds. For instance, community-based initiatives could include creating pet-friendly spaces, implementing educational campaigns on the psychological benefits of pet ownership, and offering support for individuals experiencing emotional difficulties.

Cultural differences in attitudes toward pets and human-animal relationships may influence the generalizability of these findings. For instance, in cultures where pet ownership is less common or where animals are viewed primarily as functional rather than emotional companions, the psychological benefits of pet attachment may differ. Future studies could explore cross-cultural variations to provide a more global perspective.

This study is not without limitations. The cross-sectional design precludes causal inferences, and the lack of cultural diversity in the sample may limit the generalizability of the findings to groups with differing cultural attitudes toward pets. Future research should address these limitations by employing longitudinal designs, including diverse samples, and exploring psychological factors that shape human-animal relationships.

5. Conclusions

This study empirically confirmed the significant roles of attachment to pets and the human-animal bond in the relationship between depressive symptoms and subjective well-being. In particular, the human-animal bond served as a protective mechanism, mitigating the negative effects of depressive symptoms on subjective well-being.

These findings underscore the potential of pets as valuable resources for emotional stability and the enhancement of well-being. The results provide a robust foundation for developing psychological intervention programs, such as animal-assisted therapy, and for implementing policies to strengthen human-animal relationships. Future longitudinal studies targeting diverse populations are warranted to further validate and expand upon these findings.

Author Contributions: Author Contributions: Conceptualization, Jiyu Sung; methodology, Jiyu Sung; software, Jiyu Sung; validation, Jiyu Sung; formal analysis, Jiyu Sung; investigation, Jiyu Sung; resources, Jiyu Sung; data curation, Jiyu Sung; writing—original draft preparation, Jiyu Sung; writing—review and editing, Jiyu Sung; visualization, Jiyu Sung; supervision, Jiyu Sung; project administration, Jiyu Sung. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Bioethics Committee of Konkuk University (IRB, project number: 7001355-202404-HR-788, approval date: May 2024).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on request from the author for scientific purposes.

The data presented in this study are openly available in Zenodo at Doi:10.5281/zenodo.16938483.

Acknowledgments: The authors would like to thank all pet owners who participated in this study for their cooperation and support.

Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations (약어)

The following abbreviations are used in Table 4 of this manuscript:

a	Human-Animal Bonding

 doi:10.20944/preprints202509.0143.v1

b	Depression
c	Pet Attachment
d	General attachment
e	Person substitution
f	Subjective Well-Being
g	Life Stisfaction
h	Positive/Negative Emotions
i	Quality of Life
j	Environmental
k	Physical health
l	Psychological
m	Social relationships
M	Mean
SD	standard deviation

Appendix A

Appendix A.1

Table A1. Frequency Analysis of Demographic Variables.

n=391

Factors	Category	N	%
Gender	Male	137	35.0
	Female	254	65.0
Age Group	20 to 29 years old	122	31.2
	30 to 39 years old	187	47.8
	40 to 49 years old	57	14.6
	50 to 59 years old	25	6.4
Education Level	Up to high school	62	15.9
	College	80	20.5
	Undergraduate degree	239	61.1
	Graduate degree	10	2.6
Occupation	Student	19	4.9
	Office Worker	266	68.0
	Self-employment	67	17.1
	Other (unemployed)	39	10.0
Income Status	Income	333	85.2
	No Income	58	14.8
Marital Status	Married	121	30.9
	Single(non-marital)	270	69.1
Monthly Income	Less than $1,500	41	10.5
	$1,500 and $2,000	145	37.1
	$2,000 and $3,000	153	39.1
	Over $ 3,000	52	13.3

 doi:10.20944/preprints202509.0143.v1

Type of Pet	Dog	274	70.1
	Cat	105	26.9
	Both	12	3.1
Pet ownership Experience	First	295	75.4
	Second over	96	24.6
Number of Pets	1 dog	342	87.5
	2 dogs over	49	12.5
Pet Age	< 3 years old	151	38.6
	4 to 6 years old	171	43.7
	7 to 9 years old	51	13.0
	>10 years old	18	4.6
Duration of Pet Ownership	< 3 years	157	40.2
	4 to 6 years	147	37.6
	7 to 9 years	46	11.8
	>10 years	41	10.5
	Total	391	100.0

N, Frequency; %, Percentage.

Table A2. Factor Loadings and Significance Levels for the Lexington Pet Attachment Scale (LAPS) Subfactors.

n=391

Factor	*Indicator*	*Estimate*	*SE*	*Z*	*p-value*
General Attachment	A_1	0.474	0.033	14.170	.001
	A_2	0.461	0.037	12.530	.001
	A_3	0.485	0.034	14.480	.001
	A_4	0.522	0.035	14.840	.001
	A_5	0.502	0.035	14.470	.001
	A_6	0.454	0.061	7.440	.001
	A_7	0.55	0.038	14.480	.001
	A_8	0.497	0.035	14.170	.001
	A_9	0.552	0.039	14.100	.001
People Substituting	A_10	0.478	0.035	13.660	.001
	A_11	0.478	0.035	13.550	.001
	A_12	0.44	0.035	12.500	.001
	A_13	0.463	0.035	13.290	.001
	A_14	0.483	0.045	1.820	.001
	A_15	0.443	0.04	11.030	.001

 doi:10.20944/preprints202509.0143.v1

	A_16	0.507	0.036	14.010	.001
	A_17	0.466	0.041	11.450	.001
	A_18	0.57	0.039	14.610	.001

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

References

1. Statistics Korea National Quality of Life 2023; 2024;
2. Applebaum, J.W.; Ellison, C.; Struckmeyer, L.; Zsembik, B.A.; McDonald, S.E. The Impact of Pets on Everyday Life for Older Adults during the COVID-19 Pandemic. *Frontiers in public health* **2021**, *9*, 652610.
3. KB Financial Research Center. 2023 Korea Pet Report Available online: https://www.kbfg.com/kbresearch/report/reportView.do?reportId=2000396 (accessed on 25 June 2023).
4. Sung, J.Y.; Han, J.S. Exploring the Role of Empathy as a Dual Mediator in the Relationship between Human–Pet Attachment and Quality of Life: A Survey Study among Adult Dog Owners. *Animals* **2023**, *13*, 2220.
5. Beck, L.; Madresh, E.A. Romantic Partners and Four-Legged Friends: An Extension of Attachment Theory to Relationships with Pets. *Anthrozoös* **2008**, *21*, 43–56.
6. Charles, N. Post-Human Families? Dog-Human Relations in the Domestic Sphere. *Sociological Research Online* **2016**, *21*, 83–94, doi:10.5153/sro.3975.
7. Hirschman, E.C. Consumers and Their Animal Companions. *Journal of consumer research* **1994**, *20*, 616–632.
8. Archer, J. Why Do People Love Their Pets? *Evolution and Human behavior* **1997**, *18*, 237–259.
9. Bowlby, J. *Attachment and Loss*; Random House, 1969;
10. Daly, B.; Morton, L.L. Children with Pets Do Not Show Higher Empathy: A Challenge to Current Views. *Anthrozoös* **2003**, *16*, 298–314.
11. Sable, P. The Pet Connection: An Attachment Perspective. *Attachment* **2016**, *10*, 199–210.
12. Serpell, J.A. Having Our Dogs and Eating Them Too: Why Animals Are a Social Issue. *Journal of Social Issues* **2009**, *65*, 633–644, doi:10.1111/j.1540-4560.2009.01617.x.
13. Walsh, F. Human-Animal Bonds I: The Relational Significance of Companion Animals. *Family process* **2009**, *48*, 462–480.
14. Grier, K.C. *Pets in America: A History*; UNC Press Books, 2006;
15. Ho, J.; Hussain, S.; Sparagano, O. Did the COVID-19 Pandemic Spark a Public Interest in Pet Adoption? *Frontiers in Veterinary Science* **2021**, *8*, 647308.
16. Jezierski, T.; Camerlink, I.; Peden, R.S.; Chou, J.-Y.; Sztandarski, P.; Marchewka, J. Cat Owners' Perception on Having a Pet Cat during the COVID-19 Pandemic. *PLoS One* **2021**, *16*, e0257671.
17. Morgan, L.; Protopopova, A.; Birkler, R.I.D.; Itin-Shwartz, B.; Sutton, G.A.; Gamliel, A.; Yakobson, B.; Raz, T. Human–Dog Relationships during the COVID-19 Pandemic: Booming Dog Adoption during Social Isolation. *Humanit Soc Sci Commun* **2020**, *7*, 1–11, doi:10.1057/s41599-020-00649-x.
18. Parry, N.M. COVID-19 and Pets: When Pandemic Meets Panic. *Forensic Science International: Reports* **2020**, *2*, 100090.
19. Health for Animals *Global State of Pet Care: Stats, Facts and Trends.*; Health for Animals, 2022; pp. 1–38;.
20. Value Finder Global and Domestic Pet Industry Analysis Report_May Your Pet Live a Long and Happy Life with Humans; Value Finder, 2023; pp. 7–20;.
21. Bussolari, C.; Currin-McCulloch, J.; Packman, W.; Kogan, L.; Erdman, P. "I Couldn't Have Asked for a Better Quarantine Partner!": Experiences with Companion Dogs during Covid-19. *Animals* **2021**, *11*, 330.
22. Clark Cline, K.M. Psychological Effects of Dog Ownership: Role Strain, Role Enhancement, and Depression. *The Journal of Social Psychology* **2010**, *150*, 117–131, doi:10.1080/00224540903368533.
23. Hoffmann, A.O.; Lee, A.H.; Wertenauer, F.; Ricken, R.; Jansen, J.J.; Gallinat, J.; Lang, U.E. Dog-Assisted Intervention Significantly Reduces Anxiety in Hospitalized Patients with Major Depression. *European Journal of Integrative Medicine* **2009**, *1*, 145–148.

 doi:10.20944/preprints202509.0143.v1

24. Le Roux, M.C.; Kemp, R. Effect of a Companion Dog on Depression and Anxiety Levels of Elderly Residents in a Long-term Care Facility. *Psychogeriatrics* **2009**, *9*, 23–26, doi:10.1111/j.1479-8301.2009.00268.x.
25. Meehan, M.; Massavelli, B.; Pachana, N. Using Attachment Theory and Social Support Theory to Examine and Measure Pets as Sources of Social Support and Attachment Figures. *Anthrozoös* **2017**, *30*, 273–289, doi:10.1080/08927936.2017.1311050.
26. Wells, D.L. The Effects of Animals on Human Health and Well-Being. *Journal of social issues* **2009**, *65*, 523–543.
27. Branson, S.M.; Boss, L.; Cron, S.; Turner, D.C. Depression, Loneliness, and Pet Attachment in Homebound Older Adult Cat and Dog Owners. *Journal of Mind and Medical Sciences* **2017**, *4*, 38–48.
28. Sharpley, C.; Veronese, N.; Smith, L.; López-Sánchez, G.F.; Bitsika, V.; Demurtas, J.; Celotto, S.; Noventa, V.; Soysal, P.; Isik, A.T. Pet Ownership and Symptoms of Depression: A Prospective Study of Older Adults. *Journal of Affective Disorders* **2020**, *264*, 35–39.
29. Watson, N.L.; Weinstein, M.L. Pet Ownership in Relation to Depression, Anxiety, and Anger in Working Women. *Anthrozoös* **1993**, *6*, 135–138, doi:10.2752/089279393787002295.
30. Alonso, D.F.; Bailey, P.E. A Systematic Review and Meta-Analysis of Subjective Age and the Association With Cognition, Subjective Well-Being, and Depression. *The Journals of Gerontology: Series B* **2021**, *76*, 471–482, doi:10.1093/geronb/gbaa069.
31. Burns, R.A.; Anstey, K.J.; Windsor, T.D. Subjective Well-Being Mediates the Effects of Resilience and Mastery on Depression and Anxiety in a Large Community Sample of Young and Middle-Aged Adults. *Aust N Z J Psychiatry* **2011**, *45*, 240–248, doi:10.3109/00048674.2010.529604.
32. Cummins, R.A. Subjective Well-Being, Homeostatically Protected Mood and Depression: A Synthesis. In *The Exploration of Happiness*; Delle Fave, A., Ed.; Happiness Studies Book Series; Springer Netherlands: Dordrecht, 2013; pp. 77–95 ISBN 978-94-007-5701-1.
33. Diener, E.; Suh, E.M.; Lucas, R.E.; Smith, H.L. Subjective Well-Being: Three Decades of Progress. *Psychological bulletin* **1999**, *125*, 276.
34. Bi, H. Research on the Effects of Pet Companionships on People's Well-Being. Addressing Global Challenges-Exploring Socio-Cultural Dynamics and Sustainable Solutions in a Changing World **2025**, 757–768.
35. Ellis, A.; Stanton, S.C.; Hawkins, R.D.; Loughnan, S. The Link between the Nature of the Human–Companion Animal Relationship and Well-Being Outcomes in Companion Animal Owners. *Animals* **2024**, *14*, 441.
36. Endries, A.R. Examining the Effects of Emotional Support and Therapy Animals on Anxiety and Depression in University Students: A Literature Review. **2024**.
37. Hawkins, R.D.; Williams, J.M.; SPCA), S.S. for the P. of C. to A. (Scottish Childhood Attachment to Pets: Associations between Pet Attachment, Attitudes to Animals, Compassion, and Humane Behaviour. *International journal of environmental research and public health* **2017**, *14*, 490.
38. Impram, O.; Allahverdi, F.Z. Feasibility of Animal-Assisted Therapy in the Treatment of Depression. *Psikiyatride Güncel Yaklaşımlar* **2024**, *16*, 543–553.
39. Mitchell, J.J.; Jeon, M. Exploring Emotional Connections: A Systematic Literature Review of Attachment in Human-Robot Interaction. *International Journal of Human–Computer Interaction* **2025**, 1–22, doi:10.1080/10447318.2024.2445100.
40. Song, Y.; Jung, Y.; Choi, Y.; Yoon, M. Effects of Canine-Assisted Intervention on Stress and Depression in Humans. *Journal of Animal Science and Technology* **2025**.
41. Zebrowska, M.; Strohmaier, S.; Huttenhower, C.; Eliassen, A.H.; Zeleznik, O.A.; Westgarth, C.; Huang, T.; Laden, F.; Hart, J.E.; Rosner, B.; et al. Pet Attachment and Anxiety and Depression in Middle-Aged and Older Women. *JAMA Netw Open* **2024**, *7*, e2424810, doi:10.1001/jamanetworkopen.2024.24810.
42. Miklósi, Á.; Soproni, K. A Comparative Analysis of Animals' Understanding of the Human Pointing Gesture. *Animal cognition* **2006**, *9*, 81–93.
43. Udell, M.; Spencer, J.; Dorey, N.; Wynne, C. Human-Socialized Wolves Follow Diverse Human Gestures… and They May Not Be Alone. *International Journal of Comparative Psychology* **2012**, *25*.

44. Hall, S.S.; Gee, N.R.; Mills, D.S. Children Reading to Dogs: A Systematic Review of the Literature. *PloS one* **2016**, *11*, e0149759.
45. Hare, B.; Tomasello, M. Domestic Dogs (Canis Familiaris) Use Human and Conspecific Social Cues to Locate Hidden Food. *Journal of Comparative Psychology* **1999**, *113*, 173.
46. Vormbrock, J.K.; Grossberg, J.M. Cardiovascular Effects of Human-Pet Dog Interactions. *Journal of behavioral medicine* **1988**, *11*, 509–517.
47. Bochicchio, V.; Scandurra, C.; Dolce, P.; Scandurra, A.; Freda, M.F.; Mezzalira, S. Affective Regulation and Trait Anger Personalities: The Buffering Effect of the Companion Animal Bond. *Eur J Investig Health Psychol Educ* **2024**, *14*, 2377–2389, doi:10.3390/ejihpe14080157.
48. Janssens, M.; Eshuis, J.; Peeters, S.; Lataster, J.; Reijnders, J.; Enders-Slegers, M.J.; Jacobs, N. The Pet-Effect in Daily Life: An Experience Sampling Study on Emotional Wellbeing in Pet Owners: : *Anthrozoös* **2020**, *33*, 579–588.
49. Namekata, D.; Yamamoto, M. Companion Animal Ownership and Mood States of University Students Majoring in Animal Sciences during the COVID-19 Pandemic in Japan. *Animals (Basel)* **2021**, *11*, 2887, doi:10.3390/ani11102887.
50. Smith, M. The'pet Effect': Health Related Aspects of Companion Animal Ownership. *Australian family physician* **2012**, *41*, 439–442.
51. Radloff, L.S. The CES-D Scale: A Self-Report Depression Scale for Research in the General Population. *Applied Psychological Measurement* **1977**, *1*, 385–401, doi:10.1177/014662167700100306.
52. Jeon, G.G.; Choi, S.J.; Yang, B.C. Development of an Integrated Korean Version of CES-D. *Journal of the Korean Psychological Association: Health* **2001**, *6*, 59–76.
53. Johnson, T.P.; Garrity, T.F.; Stallones, L. Psychometric Evaluation of the Lexington Attachment to Pets Scale (Laps). *Anthrozoös* **1992**, *5*, 160–175, doi:10.2752/089279392787011395.
54. Poresky, R.H. The Companion Animal Bonding Scale: Internal Consistency and Factor Structure When Administered by Telephone. *Psychol Rep* **1997**, *80*, 937–939, doi:10.2466/pr0.1997.80.3.937.
55. Seo, E.G.; Koo, J.S. A Concise Measure of Subjective Well-Being (COMOSWB): Scale Development and Validation. *The Korean Journal of Social and Personality Psychology* **2011**, *25*, 95–113.
56. Hayes, A.F. Partial, Conditional, and Moderated Moderated Mediation: Quantification, Inference, and Interpretation. *Communication Monographs* **2018**, *85*, 4–40, doi:10.1080/03637751.2017.1352100.
57. Hayes, A.F. Mediation, Moderation, and Conditional Process Analysis. Introduction to mediation, moderation, and conditional process analysis: A regression-based approach **2013**, 1, 12–20.
58. Kline, R.B. Convergence of Structural Equation Modeling and Multilevel Modeling. *The SAGE handbook of innovation in social research methods* **2011**, 562–589.
59. Spiller, S.A.; Fitzsimons, G.J.; Lynch, J.G.; Mcclelland, G.H. Spotlights, Floodlights, and the Magic Number Zero: Simple Effects Tests in Moderated Regression. *Journal of Marketing Research* **2013**, *50*, 277–288, doi:10.1509/jmr.12.0420.
60. Aiken, L.S.; West, S.G.; Reno, R.R. Multiple Regression: Testing and Interpreting Interactions; sage, 1991;
61. Johnson, P.O.; Fay, L.C. The Johnson-Neyman Technique, Its Theory and Application. *Psychometrika* **1950**, *15*, 349–367, doi:10.1007/BF02288864.
62. Meltzer-Brody, S.; Davidson, J.R.T. Completeness of Response and Quality of Life in Mood and Anxiety Disorders. *Depress. Anxiety* **2000**, *12*, 95–101, doi:10.1002/1520-6394(2000)12:1+%3C95::AID-DA14%3E3.0.CO;2-U.
63. Zilcha-Mano, S.; Mikulincer, M.; Shaver, P.R. Pet in the Therapy Room: An Attachment Perspective on Animal-Assisted Therapy. *Attachment & Human Development* **2011**, *13*, 541–561, doi:10.1080/14616734.2011.608987.
64. Beetz, A.M. Theories and Possible Processes of Action in Animal Assisted Interventions. *Applied Developmental Science* **2017**, *21*, 139–149, doi:10.1080/10888691.2016.1262263.
65. Beetz, A.; Julius, H.; Turner, D.; Kotrschal, K. Effects of Social Support by a Dog on Stress Modulation in Male Children with Insecure Attachment. *Frontiers in psychology* **2012**, *3*, 352.
66. Cohen, S.; Wills, T.A. Stress, Social Support, and the Buffering Hypothesis. *Psychological bulletin* **1985**, *98*, 310.

 doi:10.20944/preprints202509.0143.v1

67. Rynearson, E.K. Humans and Pets and Attachment. *The British Journal of Psychiatry* **1978**, *133*, 550–555.
68. Kurdek, L.A. Pet Dogs as Attachment Figures for Adult Owners. *Journal of Family Psychology* **2009**, *23*, 439.