

**Exploring the Influence of Physical Activity on the Relationship Between Basic  
Psychological Needs and Meaning in Life: A Mixed-Method Approach**

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## Abstract

**Background.** To optimise well-being across all ages, it is essential that the basic psychological needs (BPN) are fulfilled which postulated by the self-determination theory. Because physical activity is also a predictor of health, besides the basic needs, it is important to consider the physical influence to create a holistic approach. **Objective.** This study aims to examine the relationship between basic psychological needs (autonomy, competence, and relatedness) and meaning in life (coherence, purpose, significance), and how physical activity (PA) moderates this relationship through a mixed-method design. **Methods.** The final sample of this study comprised 271 participants ( $M = 45.1$ ,  $SD = 16.9$ ) which makes up for a cross-sectional subset (first wave) of a larger longitudinal study on menopause. The Basic Psychological Needs Satisfaction and Frustration Scale, the Three-Dimensional Meaning in Life Scale (3DM) and a question about PA frequency were used in combination with responses to an open check-in question. **Results.** In line with the hypothesis, PA moderates the relationship between only BPN satisfaction and meaning in life (MIL). Through a deductive qualitative analysis approach, it was found that people that were high on PA, also reported more BPN satisfaction than frustration and reported higher MIL. **Conclusion.** Consistent with prior studies, the present study found support for the prediction of MIL through the fulfilment and frustration of the BPN moderated by PA. This study promotes harmonious lifestyles by combining psychological as well as physiological predictors of well-being so that mental health problems can be prevented, and flourishing can be fostered.

**Keywords:** *basic psychological needs, meaning in life, physical activity, mixed-methods*

## **Exploring the Influence of Physical Activity on the Relation Between Basic Psychological Needs and Meaning in Life: A Mixed-Method Approach**

There is a growing need to address mental health issues among youth, but also older adults (Augsberger et al., 2023; Reynolds et al., 2020). Violation of human psychological needs and low meaning in life are equally important in predicting such mental health issues, that is, problem behaviour and psychopathological outcomes (Ryan & Deci, 2000; Vansteenkiste & Ryan, 2013). Hence, this makes the basic psychological needs and meaning in life necessary to on the one hand address for prevent negative outcomes and on the other hand foster well-being. Environments in which the psychological needs are conflicting provide more risk for psychopathology (Ryan and Deci, 2000). For example, a child relinquishes autonomy in order to feel loved by the parents. In the long term, this behaviour can become problematic for the child while there is already a significant increase in referrals to child and adolescent mental health services (Lynch et al., 2022). In addition to basic psychological needs, lacking meaning in life is associated with depression, hopelessness, deficits in emotion regulation and even suicide (Marco et al., 2015). Moreover, Huo et al. (2019) conducted a study in which they found that people who have low meaning in life are more prone to developing mood disorders, such as depression compared to people who perceive life as meaningful. Due to the fact that depression is one of the main causes of the mortality rate worldwide, it is important to reduce the risk as much as possible by addressing meaning in life next to basic needs (Grossberg & Rice, 2023). Psychological factors but also physiological factors contribute to mental health. A plethora of mental health disorders can be heavily influenced by physical inactivity (Denche-Zamorano et al., 2022). Thus, it is important to incorporate both psychological factors as well as physical activity for promoting well-being and preventing mental health issues.

## **Basic Psychological Needs**

To optimise well-being across all ages, human basic needs have to be fulfilled both physically as well as psychologically (Ryan & Deci, 2000). Focusing on the psychological aspect, the three basic psychological needs are considered “essential nutrients”, emphasising the importance of the satisfaction of these needs (p. 75). Ryan and Deci (200) developed the Self-Determination Theory (SDT), and it postulates that the satisfaction of the three needs for competence, autonomy, and relatedness contributes to well-being and continuously feeling a sense of integrity (Vansteenkiste et al., 2020). In short, competence is the sense of capability and effectiveness, e.g., that a student feels capable of completing a difficult test. Autonomy is the experience of volition, for example, when a child is free to decide on what clothes to wear rather than a parent imposing clothes to wear. Relatedness refers to the connection with others, this is satisfied when a person experiences warm relationships with family and friends (Van der Kaap-Deeder et al., 2020). Thus, as demonstrated by a cross-cultural comparative study across multiple nations representing four different cultures (Chen et al., 2014), basic psychological needs are important determinants of well-being, and genuine and warm interpersonal relationships (Ryan & Deci, 2022).

## **Meaning in Life**

Prior studies have emphasised that satisfaction with these basic psychological needs promotes meaning in life (Lambert et al., 2013; Steger & Samman, 2012; Trent & King, 2010). Meaning in life tries to capture to what extent a person feels that life makes sense, has a purpose, and matters to others relating to the three dimensions, significance, purpose, and coherence (King & Hicks, 2021). Coherence means the comprehension and sense of life an individual has made, while purpose comprises an individual’s aims and aspirations for life. The third dimension is significance, about a person’s feeling to what extent life matters (Heintzelman & King, 2014). The study of García-Alandete (2015) showed that purpose in life predicted

psychological well-being in a sample of 180 Spanish students. This is supported by Fischer et al. (2020), who found that meaning in life is an important predictor of well-being and quality of life across different cultures. In turn, decreased meaning in life is associated with more stressful experiences. So, meaning in life and the basic psychological needs are independently crucial to promote well-being, how the basic needs and meaning in life relate to each other needs further investigation.

### **Basic Psychological Needs and Meaning in Life**

One way in which the basic psychological needs and meaning in life are associated with each other is that people who score higher on facets of basic psychological needs also score higher on meaning in life shown in several studies. This suggests that there is some type of relationship between the satisfaction of basic psychological needs and meaning in life. For example, while evaluating the psychometric values of the meaning in life scale, the study of Steger and Samman (2012) found that all three basic psychological needs positively correlated with meaning in life. The strongest correlation with meaning in life was the level of satisfaction of free control over life choices referring to autonomy. These findings are also supported by the study of Martela et al. (2017), comparing four need satisfactions (i.e., autonomy, competence, relatedness, and beneficence) with positive affect as indicators for meaning in life using an experiencing sampling method. They emphasise the immediate and daily impact of the satisfaction of the psychological needs on the perceived meaning in life. Besides, Trent and King (2010) performed an experimental study that found that autonomy and social relatedness were positively associated with one of the first things that came to mind in rapid judgment of meaning in life compared to thoughtful assessment of meaning in life. To support this even more, Lambert et al. (2013) conducted research using multiple designs (i.e., cross-sectional, longitudinal, and experimental) showing that a sense of belonging is positively correlated with meaning in life. Furthermore, Lambert et al. (2013) found that this sense of belonging predicted

meaning in life in a way that individuals who experienced high belongingness and social support also scored highest on the meaning in life. Reversely, Stillman et al. (2009) conducted two experimental studies in which a manipulated social isolation environment was created, and these individuals reported a lower meaningful life than individuals who participated in a neutral or accepting environment. Moreover, their third experimental study demonstrated that individuals who perceived higher, natural feelings of loneliness also reported a lower meaning in life. So, these studies provide support for the association between both satisfaction and frustration and a change in meaning in life.

However, Zhang et al. (2022) demonstrate the bidirectional relationship between basic psychological needs and meaning in life. For instance, having a strong meaning in life influences interpersonal resources such as motivation and a sense of purpose so that specific goals can be completed, leading to an increased sense of competence. Furthermore, how meaning in life can affect psychological needs is that an enhanced meaning in life can facilitate the social attractiveness of an individual, which in turn improves relationships with others, hence, improving relatedness as a psychological need (Stillman et al., 2010). Concluding, that the basic psychological needs and meaning in life enhance each other depicts the complex relation between well-being factors, promoting further investigation into these predictors.

Of all these studies mentioned above and the remaining studies on the three needs and meaning in life, the majority demonstrate their findings through a quantitative analysis. In contrast to this, qualitative research is scarce on the relationship between basic needs and meaning in life. A unique example of qualitative research is the second study of Lambert et al. (2013), it includes an essay to explore the determinants of meaning in life, adopting a qualitative approach. Adopting qualitative methods would gain insight into a more thorough and nuanced understanding of experiences, feelings and beliefs about basic needs and meaningfulness of life instead of solely utilising quantitative methods that use scores on

predefined concepts and items. In short, the addition of qualitative data would contribute to the field of existing literature on the relation between basic psychological needs and meaning in life as it would provide a more detailed context in which they are experienced.

### **Physical Activity**

While basic psychological needs and meaning in life focus on mental concepts of well-being, physical activity addresses the physiological aspect of well-being in individuals. So, in the first place, investigating physical activity in combination with psychological factors would be a complementary and more holistic approach to improving well-being. In the second place, it is found that students perceive a lack of meaning in life and exercising can make life more meaningful. In the third place, a key factor in the prevention of mental health issues and ensuring well-being is engaging in physical activity (Wanjau et al., 2023). Overall, despite its commonly acknowledged benefits on mental health, there is a plethora of research that can still be done on the impact of physical activity on predictors of well-being (i.e., basic psychological needs).

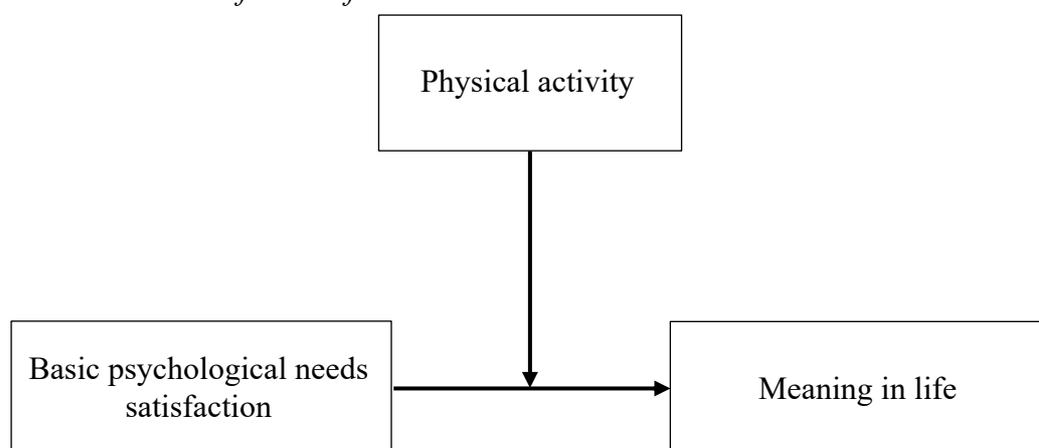
What is already known about physical activity influencing basic psychological needs is, for example, sports environments provide both positive and negative occurrences. Participating in sports such as youth sports could, therefore, affect psychological needs satisfaction and frustration which in turn influences motivation and well-being (Warburton et al., 2019). Correspondingly, Wilson et al. (2003) conducted a study in which they investigated the interactions between psychological needs, motivation, exercise attitudes and physical fitness. They found increased competence and relatedness during a prescribed exercise program of twelve weeks. In conclusion, it is known how basic psychological needs can be influenced in a sports environment, but not in a different, broader context.

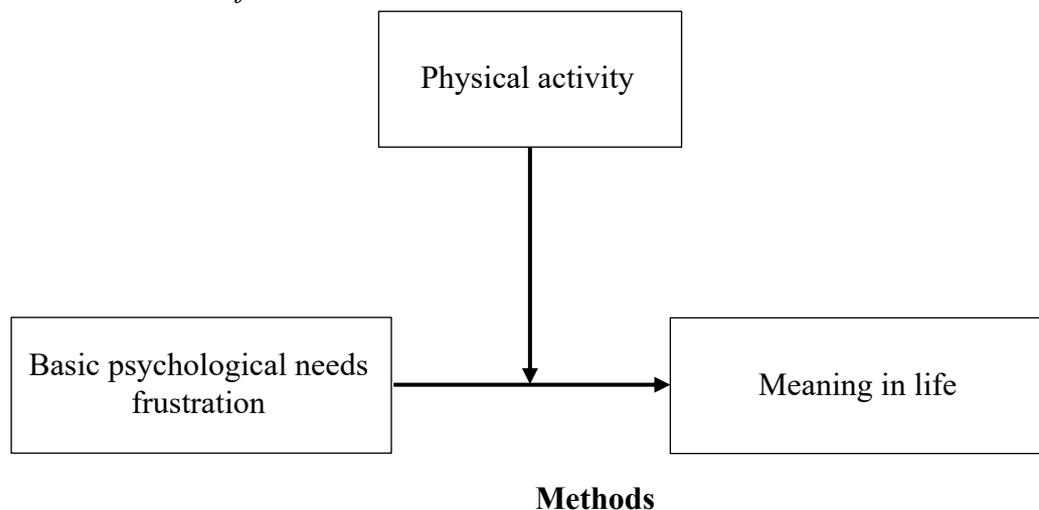
## Present Research

This research aims to investigate the relation between the basic psychological needs (autonomy, competence, and relatedness) and meaning in life (coherence, purpose, and significance), and the moderating role of the physical activity using a mixed method approach. It is expected that (H1) there is a positive relationship between basic psychological needs satisfaction and meaning in life. Reversely, it is expected that (H2) there is a negative relationship between basic psychological needs frustration and meaning in life. Finally, it is expected that (H3) physical activity moderates the relationship between basic psychological needs and meaning in life, see Figure 1 and Figure 2. In addition, due to the mixed-method approach, the qualitative results will support or reject the moderating effect of physical activity on basic psychological needs and meaning in life. To clarify, this study makes use of methodological triangulation in which the qualitative results will provide context to the quantitative findings. Hence, for the qualitative data, it is expected that people who report high physical activity, also report fulfilment of the basic psychological needs and perceive life as meaningful. At last, this research will enrich the comprehension of underlying mechanisms of psychological well-being and provide pragmatic involvement for facilitating healthier lifestyles.

### Figure 1

*Moderation Model for Satisfaction*



**Figure 2***Moderation Model for Frustration***Design**

The present study was part of a more extensive, longitudinal research with a mixed-methods approach assessing the midlife and menopausal attitudes, complaints and positive mental health of men and women over twelve months. This study uses a cross-sectional subset of this data, which consists of the first wave out of the four times data is collected from the longitudinal study. The ethical approval was granted by the BMS/HSS Ethical Committee of the University of Twente whereby anonymity and confidentiality are safeguarded, with the following request number 231487.

**Participants**

There was a total of 638 participants who signed up to participate in the longitudinal study. Due to the not signed informed consent, 43 (7%) people were excluded, leaving 595. There were also 135 (21%) participants excluded because they did not fill in all demographic information. As the present study focuses on the basic psychological needs, meaning in life and the lifestyle factor of physical activity, the 173 (27%) individuals who did not fill in these questionnaires completely were removed. The last elimination of 16 (3%) participants is of those who did not fill in the open question, resulting in 271 people who are included in the data

set ( $N = 271$ ). Participants were on average 45.1 years old ( $SD = 16.9$ ). Both women and men aged 18 years and older are included in the sample. Furthermore, they have to be able to complete all online surveys either in English, Dutch, or German. Information on frequencies of the demographic characteristics gender and nationality can be found in Table 1. Appendix A contains a copy of the questions and all answer options on basic information of the participants.

**Table 1**

*Sociodemographic Characteristics at Baseline*

Demographic characteristic	<i>N</i>
Gender	
Female	234
Male	33
Non-binary	2
Prefer not to say	2
Nationality	
Dutch	131
German	102
Belgian	3
Turkish	19
Moroccan	16

**Measures**

As this study used data from a larger longitudinal study, there were questionnaires included that will not contribute to the purpose of this study. This study includes the Basic Psychological Need Satisfaction and Frustration Scale (BPNSFS), the Three-Dimensional Meaning in Life Scale (3DM) and a lifestyle questionnaire about physical activity. Before using the questionnaires, the Cronbach's alpha was computed to ensure reliability. The internal consistency is in the range between .76 and .95 which is considered fairly high (Taber, 2017) and excellent (Bonett & Wright, 2014), see Table 2 below. Next to that, for the qualitative analysis, a check-in question was asked.

**Table 2***Item Reliability Statistics*

Subscales	Mean	SD	Items	Cronbach's alpha
3DM	5.28	.91	11	.90
Coherence	5.29	.96	4	.78
Purpose	5.26	1.12	4	.87
Significance	5.29	1.15	3	.80
BPNSFS				
Satisfaction	7.85	1.00	12	.87
Autonomy	3.74	.64	4	.76
Competency	3.82	.65	4	.80
Relatedness	4.22	.54	4	.81
Frustration	4.41	1.30	12	.89
Autonomy	2.68	.65	4	.84
Competency	2.17	.86	4	.86
Relatedness	1.77	.66	4	.80

***Basic Needs Scale***

The satisfaction and frustration of the basic psychological needs were measured through three items autonomy, competence and relatedness. Van der Kaap-Deeder et al. (2020) developed the BPNSFS which contains 24 statements (e.g., *I feel capable about what I do; I experience a warm feeling with the people I spent time with*) which are answered on a 5-point scale ranging from 1 = *Not true at all* to 5 = *Completely true*. Lataster et al. (2022) found that the internal consistency of the total BPNSFS could be considered excellent ( $\alpha = 0.90$ ). More specifically, Martela et al. (2017) found that the reliabilities of the subscales separately were good for autonomy ( $\alpha = 0.82$ ), competency ( $\alpha = 0.90$ ), and relatedness ( $\alpha = 0.87$ ).

***Meaning in Life***

The 3DM measures the construct coherence, purpose and significance over eleven propositions (Martela & Steger, 2022). Coherence and purpose both have four propositions (e.g., *I can easily make sense of my life; I pursue one or more big purposes in my life*), while

significance has three (e.g., *My life is full of value*). Participants rated this on a 7-point scale ranging from 1 = *not at all true* to 7 = *very true*. According to Rose et al. (2016), the Cronbach's alpha values ranged from .86 and .88, indicating good internal consistency.

### ***Physical Activity***

Physical activity was part of the lifestyle questionnaire also including other lifestyle factors such as drinking, smoking, and diet. To measure physical activity, one quantitative item was used "*How often do you exercise? (for example a ball game, the gym, walking, cycling, rowing)*" This was answered on a 5-point scale, ranging from almost daily to never, representing how often people exercise "Almost daily", "At least 3 times a week", "Occasionally", "Rarely", and "Never", ranging from 1 to 5 in this order.

### **Check-In Open Question**

For the qualitative data, an open question was provided which could be answered in three languages, English, Dutch and German. The following information was provided: "*We would like to hear how you have been doing in the past 4 months. You can think about how you felt, how you are doing now, what pleasant and unpleasant events or situations occurred, and what your daily life was like in the past 4 months. Try to answer as comprehensively as possible in your own words. You don't have to pay attention to spelling and typos, just write what comes to mind as much as possible.*" Due to the broad interpretation of this questions, there was the opportunity to share beliefs, attitudes, and experiences. The answers to this question make up for the qualitative data. The goal of this questions was, therefore, collecting data on experiences that relate to the three basic psychological needs, the three dimensions of meaning in life and physical activity.

### **Procedure**

Participants were recruited through the SONA system, by contacting participants who explicitly indicated that they were open to participating in further research concerning well-

being from the database of the principal researcher, and convenience sampling by contacting social circles of the researchers. Furthermore, snowball sampling was used as the contacted people were asked to forward this study to people in their social environment. Data collection took place in the first quartile of 2024, from January until the last week of March with the use of Qualtrics (<https://www.qualtrics.com/uk/>). The participants were provided with a link that provided first an application form, here they indicated in which language they wanted to participate in the study. After signing the informed consent by clicking either “yes” or “no”, participants were redirected to the online survey. It was stated that this online survey would approximately take 30-45 minutes including eight questionnaires and three open questions. In the closing section, the participants were asked to review the survey with a grade on a scale from 1-10. There was also the possibility to leave any additional remarks or recommendations. At the end, participants were thanked for their time investment.

## **Data Analysis**

### ***Quantitative Data Analysis***

#### *Data Preparation*

Due to the mixed-method approach first the quantitative data analysis part will be discussed. The data as a .sav file was loaded into R Studio version 4.3.3 to clean the data from missing values, duplicates, and errors. This was done by removing rows with missing values in the columns that were included in this study. After that, the descriptive statistics such as age range, mean and standard deviation were computed. Finally, the number of people per category, namely gender, nationality, marital status, living status, and employment stated were computed.

After analysing the socio-demographic data, the data of the BPNSFS, 3DM, and the physical activity item were investigated. Firstly, the parametric tests need to be performed in order to ensure normality, homogeneity of variance, and independence. Also, the mean,

standard deviations, and Cronbach's alpha were computed for all subscales of the BPNSFS and 3DM.

Next to this, Physical Activity is represented as a dummy variable. Points one and two indicating "Almost daily" and "At least 3 times a week" were reassigned as value one, while points four and five indicating "Rarely" and "Never" physical activity were reassigned as value zero. Point three "Occasionally" was randomly assigned to either category one or zero, the reason for this is to make sure that no pattern or preference influencing how the middle value got assigned, preventing a bias (Boussiala, 2020) and that all possible combinations are equally likely. Value one indicates a high physical activity frequency and value zero a low physical activity frequency.

#### *Hypothesis 1 and Hypothesis 2*

After data collection, the data needs to be analysed to determine how strong the relationship is between basic psychological needs (BPN) and meaning in life (3DM) and whether this relationship is affected by physical activity (PA). The mean scores of all Meaning in Life statements were computed along with the mean scores on the distinct subscales of coherence, purpose, and significance. The total mean scores of the Basic Psychological Needs questionnaire were computed too for both satisfaction and frustration separately. Moreover, the scores on autonomy, competence, and relatedness were computed for satisfaction as well as frustration.

#### *Hypothesis 3*

Finally, to test whether there is a moderation effect of physical activity on the relationship between basic psychological needs and meaning in life, a simple linear regression model was computed with an interaction effect. This model had as a dependent variable the mean score on the total meaning in life questionnaire. As independent variables, the following subscales were used basic psychological needs, basic psychological needs satisfaction, basic

psychological needs frustration, and the three subscales autonomy, competence, and relatedness both satisfaction and frustration. Physical activity was the dichotomous moderator in this model.

### ***Deductive Qualitative Analysis (DQA)***

Part two of the data analysis for the qualitative data was done through, the DQA developed by Fife and Gossner (2024). This approach initially uses a deductive analysis in combination with an inductive analysis to refine, contradict or expand the concepts to better fit the data of this sample. The English responses were kept in English while the Dutch responses remained in Dutch and were coded with the English code names. The German responses were translated with the Microsoft Word Translation tool in order to secure the confidentiality of the data.

The DQA started with importing the written survey responses from R to ATLAS.ti, a tool that supports coding, annotating, and locating parts of texts to analyse the results. A total of 15 codes were created with three codes Basic Psychological Need, Meaning in Life and Physical Activity (PA) with subcodes consisting of the subscales. PA is divided into two subcodes “High Physical Activity” and “Low Physical Activity”, this aligns with the quantitative definition of physical activity and, therefore, distinguishes between regular and daily engagement in exercises and never or rarely exercising. Consequently, the codes were assigned to the texts for which the frequencies were computed.

### ***Hypothesis 3***

To support or reject the quantitative findings of the third hypothesis, this will also be discussed through the qualitative results. As a result, the high physical activity group will be compared to the low physical activity group. This comparison is based on the satisfaction and frustration of the basic psychological needs and how the groups perceive the three dimensions of meaning in life.

## Results

### Quantitative Data

First, in order to ensure normally distributed mean scores of the participants on the meaning in life, basic psychological needs, and physical activity question, the skewness and kurtosis values were computed. Also, the normality of the residuals was determined. Second, the VIF values ranged from 1.012 to 1.042 which also supports that there is no significant correlation among the independent variables. Next to that, after removing outliers, there is support for homoscedasticity as the output of the bptest had a p-value of 0.908 for satisfaction and a p-value of 0.157 for frustration. The following results are based on data with removed outliers, for results without the removed outliers, see Appendix B. Removing the outliers did not change the significance of the variables or interaction. The main difference between the original data set and the data set with the removed outliers was the significance value of the relationship between basic psychological needs frustration and meaning in life, which was less extreme than the significance value of the original data set. Table 3 provides the Pearson correlations for each main variable showing an overview of the data before further analysis.

**Table 3**

*Correlations for Main Variables*

Variable	1	2	3
1. Meaning in life	-		
2. BPN satisfaction	0.71***	-	
3. BPN frustration	-0.58***	-0.76***	-

*Note.* \*\*\*p < .001.

### *Hypothesis 1 and Hypothesis 2*

The quantitative analysis investigated the relationship of the independent variable basic psychological needs satisfaction as well as frustration and the dependent variable meaning in life. The main effect between basic psychological needs satisfaction and the total means scores

of meaning in life was significant ( $b = .64, p < .001$ ). In addition, the other main effect between basic psychological needs frustration and the total means scores of meaning in life was significant ( $b = -.28, p < .001$ ). It should be noted that the slope of the satisfaction subscale is positive, while the slope of the frustration subscale is negative.

### ***Hypothesis 3***

To test the third hypothesis, a moderation analysis was performed using a linear model. There was only the interaction effect between the basic psychological needs satisfaction and physical activity was found to be significant ( $b = -.23, p = .039$ ), see Table 4. The interaction effect between basic psychological needs frustration and physical activity was found not to be significant ( $b = .02, p = .861$ ). Solely, the relationship between basic psychological needs satisfaction and meaning in life did differ among participants who reported a frequency of physical activity almost every day and participants who reported no physical activity at all in a week. It can be concluded that based on the quantitative results the effect of the basic psychological needs satisfaction on the meaning of life is partially moderated by the frequency of physical activity. See Figure 3 and Figure 4 for the path models of the moderation effect including the coefficients and its significance.

**Table 4**

*Regression coefficients for the interactive effect of physical activity on basic psychological needs and meaning in life*

Model 1.1	Estimate	SE	95% CI		<i>p</i>
			<i>LL</i>	<i>UL</i>	
Intercept	0.29	.78	-1.24	1.82	.709
Basic Psychological Needs Satisfaction	0.64	.10	0.45	0.83	<.001 ***
Physical Activity	2.00	.89	0.24	3.76	.026 *
Interaction	-0.23	.11	-0.45	-0.01	.039 *

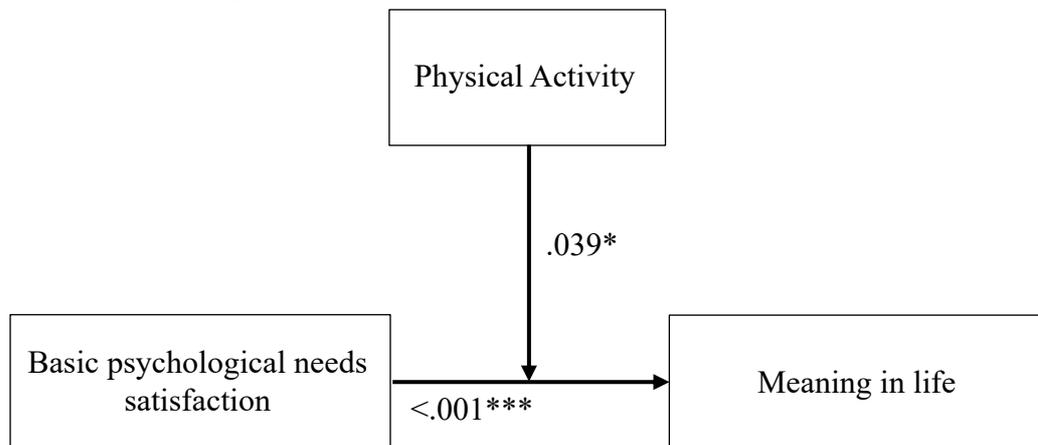
Model 1.2	Estimate	SE	95% CI		<i>p</i>
			<i>LL</i>	<i>UL</i>	
Intercept	6.60	.34	5.93	7.28	<.001***
Basic Psychological Needs Frustration	-0.28	.08	-0.43	-0.13	<.001***
Physical Activity	0.05	.39	-0.72	0.81	.899
Interaction	0.02	.09	-0.16	0.19	.861

Note. *N* = 208. *CI* = confidence interval; *LL* = lower limit; *UL* = upper limit.

\**p* < .05. \*\**p* < .01. \*\*\**p* < .001.

**Figure 3**

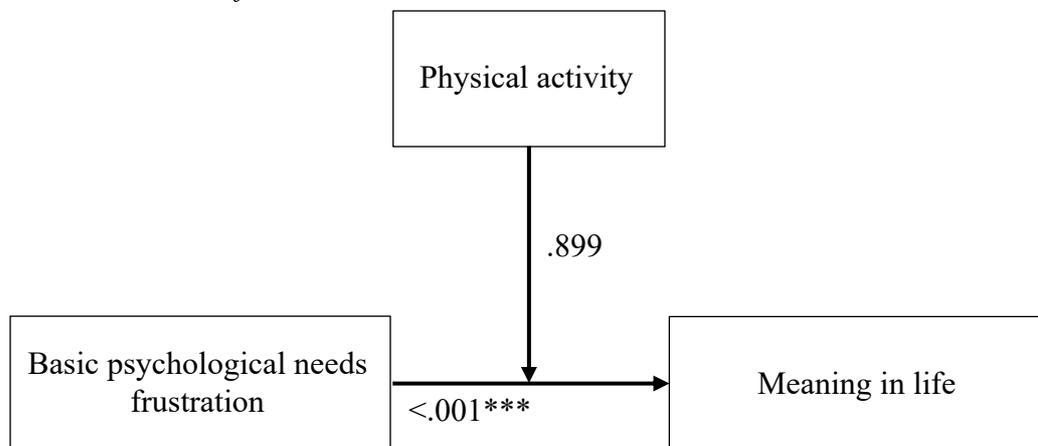
*Moderation Model for Satisfaction*



Note. \**p* < .05. \*\*\**p* < .001.

**Figure 4**

*Moderation Model for Frustration*



Note. \*\**p* < .001.

## Qualitative Data

The qualitative data was analysed through a deductive content analysis using three codes and 14 subcodes. The answers to the questions about how the participants have been doing over the past four months varied greatly. In Table 5, there is an overview of the code frequencies including an example. The example was most representative of its code based on the definition and adjusted meaning of the code. The findings of the three main codes meaning in life, basic psychological needs, and physical activity and its subscales will be discussed in this section.

**Table 5**

### *Code Frequency*

Subscales	Code frequency	<i>Example quote</i>
Meaning in Life	134 (21%)	
Coherence	41	<i>“All in all, I’m satisfied and I trust the process of life.” (P250)</i>
Purpose	71	<i>“Very quickly I was able to adapt and bring my life into a direction I wanted it to be in.” (P76)</i>
Significance	21	<i>“In general, I am very satisfied about who I am, my relationships with others, satisfied about what I do and the possibilities to do what I would like to do.” (P31)</i>
BPN	469 (72%)	
Satisfaction	271	
Autonomy	53	<i>“I am freelancer and I can decide my workload myself, the freedom with which it comes is unremarkable pleasant.” (P68)</i>
Competency	73	<i>“I have found a department in my studies that I excel at and that allows me to become more confident about myself.” (P263)</i>
Relatedness	145	<i>“I sometimes could cry out of happiness for my warm and trusting relationships.” (P33)</i>
Frustration	198	
Autonomy	50	<i>“There were times were it felt like I don't have time for myself and it was a bit stressful.” (P80)</i>

Subscales	Code frequency	Example quote
Competency	75	<i>“I am quite insecure about my abilities and myself.” (P260)</i>
Relatedness	73	<i>“Missing connectedness of relationship with a man (I am single)” (P8)</i>
PA	42 (7%)	
High PA	34	<i>“In the new year I started exercising again and that feels good.” (P126)</i>
Low PA	8	<i>“Not very committed with the goal related with exercising more.” (P226)</i>

Note. BPN = basic psychological needs. PA = physical activity

### **Coherence**

First, the three subscales of the meaning in life questionnaire represented the three codes: coherence, purpose, and significance. There was no individual that mentioned literally whether they understood life or not, which pertains to the definition of the subscale coherence. So, the meaning of this code coherence had been adjusted to a somewhat more broad and indirect interpretation of whether one understands life or not. This means that a code such as *“I’ll leave Enschede with a big crying out of happiness and sadness, which feels exactly right.” (P33)* Appears that the individual comprehends life. What also is included within this code are statements about people being satisfied with the way how life currently is or will be in the future. Meaning that they accept the way how life is for them which indicates that life makes sense, referring to one of the items measuring coherence.

### **Purpose**

The code purpose encompasses that people set specific goals for themselves, in the short term such as finishing school but also in the long term *“chasing dreams” (P167)*. On the one hand, some people gave a detailed description of what goals they wanted to achieve. On the other hand, people said they feel lost, no direction, and no purpose in life.

### ***Significance***

The final code of meaning in life is significance and this code was mentioned least. No one stated specifically that their life was of value, but such as the following statements acknowledged their importance of existence “*I have the feeling that I am useful*” (P242) and “*Feel that in 2024 I want to do even more for what I came on earth to do!*” (P42).

### ***Autonomy***

Second, for the basic psychological needs, both satisfaction and frustration are discussed per subscale representing a code. Starting with the autonomy code which many people addressed in the context of work. That is, they were able to make their own choices with work-related issues. Their autonomy at work was frustrated when, for example, the workload was too high. Some indicated that they were physically not able to move their mobile or even leave the house, then their autonomy was also frustrated. In turn, when they had to chance to move more freely, they were highly appreciative of their autonomy. Additionally, working a few days at home or being able to divide work time by themselves also satisfied the need for autonomy.

### ***Competence***

The next subscale of the basic psychological needs was competence, to what extent people feel that they have the ability to cope with the current circumstances. Both satisfaction and frustration of this subscale were addressed approximately evenly. Competence frustration was indicated in numerous contexts, such as work and school performance, completing chores, and raising children. This is in line with competence satisfaction, while things such as handling personal problems and setbacks, respecting own boundaries, and making schedules make people feel competent.

### ***Relatedness***

The last subscale relatedness was mentioned most frequent of all subscales. Here, people mentioned often that they experience warm relationships with family members, friends, and colleagues. They also express great appreciation, gratitude, and happiness towards these relationships. Nevertheless, some individuals also mentioned the opposite of losing the connection with significant others through moving to another country or with a child who has recently moved out to live independently. Furthermore, there are also people of different ages who experience a difficult relationship with their parents, indicating that they do not feel connected with them.

### ***Physical Activity***

The third main code, physical activity, was mentioned the least. There were a few people who indicated that they do not exercise at all or not frequently or regularly. Most people added the reasons for their low physical activity, examples are feeling not motivated, the Corona pandemic and physical disability. The type of physical activity in which people are engaging varies a lot. There are very short descriptions such as liking to bike and gardening, but also participating in group activities such as exercising.

### ***Hypothesis 3***

To support or reject the findings of the qualitative data analysis, the responses to the open question should be considered and put into context. First, the individuals that reported high physical activity are discussed on how they perceive meaning in life and whether their basic psychological needs are fulfilled or not. After that, the context of individuals that reported low physical activity is examined.

### ***High Physical Activity***

Eight individuals reported low physical activity and 34 individuals reported high physical activity. 34 people got the code high physical activity assigned to their response.

Considering all these responses, 72% (79 codes) of the basic psychological needs accounted for the satisfaction of these needs, while the remaining 28% (31 codes) consisted of frustration codes. 18 out of 34 stated something about meaning in life, addressing coherence, purpose and significance, only two of these people mentioned that they perceived life as purposeless and motivation for life. This means that the other 16 people perceived life as meaningful. These people addressed one subscale of meaning in life or a combination of two but never mentioned all three in one response.

### *Low Physical Activity*

The eight individuals that reported low physical activity reported similar scores on the satisfaction and frustration scale. Like the findings above, there were more satisfaction codes (19) found in the responses of these individuals compared to the frustration codes (17). The eight individuals that reported a low physical activity reported a low meaning in life, addressing the subcodes coherence, purpose, and significance. Instead, they addressed this subcode in the sense that they perceived no coherence, purpose, and/or significance. An example in which significance is violated is, *“It seems like my life is over, like it's at a standstill like I can't do important things anymore, like moving, looking for another job, travelling.”* (P197) There was one exception, that is one individual acknowledging that that person's life is limited and uncertain, but still feels happiness. However, this person also indicated a high physical activity later in the response.

## **Discussion**

The present study provides more insight into the connectedness of basic psychological needs and meaning in life. Correspondingly, the aim was to examine whether physical activity had a moderating role in the relationship between the satisfaction and frustration of basic psychological needs and the meaningfulness of life. According to the self-determination theory

(Ryan & Deci, 2002), the fulfilment of autonomy, competence, and relatedness are of paramount importance for personal growth and well-being. This research adds to the complexity of this theoretical framework by exploring factors that are related to these concepts, that is, meaning in life. Gaining more knowledge on basic psychological needs will provide more possibilities to prevent mental health problems and encourage well-being.

### **Summary and Interpretations**

This study found that the satisfaction of BPN positively predicts meaning in life, while the frustration of BPN negatively predicts meaning in life. This means that fulfilment of needs is associated with a higher meaning in life score compared to when these needs are frustrated. Hence, the first hypothesis stating that there is a significant relationship between satisfaction of basic psychological needs and meaning in life is supported by the results. In line with prior studies (Lambert et al., 2013; Steger & Samman, 2012), this research confirms the positive relationship between basic psychological needs and meaning in life. Additionally, it should be noted that only satisfaction of these needs is associated with a positive prediction of meaning in life, while frustration is associated with a negative prediction of meaning in life. To explain this Unanue et al. (2023) conducted a study in which they found that the satisfaction of needs is associated with perceiving positive experiences which, in turn, results in higher scores on meaning in life. So, in line with previous findings, basic psychological needs satisfaction positively influences the meaning of life within an individual.

The second hypothesis stating that there is a significant relationship between frustration of basic psychological needs and meaning in life is supported by the results too. This was, for example, also the case for Stillman et al. (2009) who found that individuals who felt socially rejected, experience a lower meaning in life. This negative association can be explained by that the frustration items do not measure the negated version of the satisfaction items for example “I do not feel connected with others”, but rather formulate a complementary item, e.g., “*I feel*

*lonely*". Thus, these two hypotheses reinforce existing literature as the results of this study correspond with the findings of previous studies (e.g., Lambert et al., 2013; Stillman et al., 2009).

The third hypothesis that physical activity moderates the relationship between basic psychological needs and meaning in life can be supported. However, based on the quantitative data analysis, it should be noted that the moderating effect of physical activity is significant for the relationship between only basic psychological needs satisfaction and meaning in life. In contrast, this is not the case for the relationship between the frustrated basic psychological needs and meaning in life. This is in contrast to previous literature, for example, Warburton et al. (2019) found that a sports environment influences both the satisfaction of basic psychological needs and the frustration of these needs. Although, it should be noted that meaning in life is not incorporated in this study. So, physical activity influences the relationship between basic psychological needs satisfaction and meaning, but this influence is not significant for the frustration of these needs.

Through the mixed-methods approach, the quantitative results were put into context through the responses to a check-in question which was answered openly. These results show that people who reported high physical activity also reported more satisfaction than frustration with basic psychological needs and a high meaning in life. These results also show that some individuals who were high on physical activity also reported frustration with their basic psychological needs. That autonomy frustration was mentioned can be explained by the study of Wilson et al. (2006). They found that competence and relatedness increased over an exercise program of twelve weeks, while autonomy was found to decrease over this period. In the study of Wilson et al. (2006) it was argued that the participants could have felt controlled by the exercise program, though in the study such a program was absent, it could still be the case that people felt regulating influences from other external factors such as work. Overall, it is the low

physical activity group that appears to have a similar frequency of satisfaction and frustration with basic psychological needs but does experience a low meaning in life.

### **Implication of the Findings**

These findings extend the scope of the self-determination theory. Whilst meaning in life has been addressed regularly in combination with the self-determination theory (Martela et al., 2017; Steger & Samman, 2012; Trent & King, 2010), this relationship has never been put into context about a physical activity environment. As a result, this research stimulated the incorporation of a new variable, physical activity and its environmental impact as supported in this study.

Ultimately, this study advocates for adopting holistic approaches to mental health. Mental health should not only be addressed to factors that influence psychological well-being, but it should also include physiological predictors of health and well-being. So, combining the basic psychological needs and meaning in life with physical activity shows the complexity and a representative comprehension of health and encourages to maintenance of a balanced lifestyle.

### **Limitations**

Despite the significant findings, the present study had some limitations that should be considered which provide opportunities for future research. The first limitation of the quantitative results is, remarkably, the p-value for the main effect of basic psychological needs and meaning in life is very low, namely  $<3.41e-10$  which is nearly zero. This strong effect could be explained through the sample and the correlation. The sample that is used is aimed at women to explore experiences and attitudes towards menopause, but males could also participate in the principal's research. Still, the sample includes 86% women, 12% males and 4% making up for non-binary people and people who prefer not to say. This is not representative of a general population which may lead to misinterpretation of the data. Besides, the correlation matrix shows significant correlations between the meaning of life and the basic

psychological needs satisfaction and frustration. The correlation between this variable could account for the extremely low p-value, as a strong correlation between variables reduces the reliability of the coefficients and p-value. In conclusion, both the sample and high correlation could account for the extremely low p-value.

The second limitation to consider is the measurement of physical activity. As this study was part of a larger longitudinal study, no questionnaire on physical activity was used. Instead, the question that measured physical activity frequency was part of a lifestyle questionnaire developed by the principal researcher. In brief, as the measurement of physical activity was predetermined, it might have affected the representativeness of physical activity as a variable. Thirdly, now focusing on the qualitative data analysis, due to the three language options to participate in this research, translation of the responses was necessary to code the data. The English responses were left in English, and the Dutch responses were left in Dutch, the reason for this is that the proficiency of the researcher is sufficient in both English and Dutch. Although, this was not the case for the German responses. These were translated through the Microsoft Translate function after which these responses were compatible for coding. However, it should be noted that there could be a loss of information and misinterpretation due to the translation, referring to a negative translation bias. An example of this is, "*Da hat man schlechte Karten wenn etwas schief geht.*" (P162) is a German idiom for saying that something or someone is at a disadvantage. Nevertheless, this got translated to "*You have bad cards if something goes wrong.*" In the future, randomising the order of the English and German responses could prevent bias during the coding process.

The fourth limitation is that people mostly wrote about whether their basic psychological needs were satisfied or not, especially relatedness. Quotes relating to meaning in life were significantly lower. People mentioned rarely their engagement in physical activities. This could be explained because the lifestyle questionnaire including the question about

physical activity was only asked after this open question. It could be the case that the participants were probed already as they filled already filled out the questionnaires about basic psychological needs and meaning in life, indicating the presence of the primacy effect. Also, the salience bias could have occurred to explain why people reported little information on physical activity. All in all, this question could be asked first to avoid any methodological errors.

The present study did not only find limitations but there are also some strengths. A first strength is the mixed-methods design compared to merely quantitative data or qualitative data. Besides, the methodological triangulation provides a context to the quantitative findings. In this case, for instance, autonomy can be addressed in multiple contexts. Autonomy was found to be described as work or the ability to move. Another interesting finding was that meaning in life was different and broader mentioned in the open question. Whereas in the 3DM there are items that measure the three constructs. And so, the qualitative data provides context to the quantitative data.

A second strength is the formulation of the open question that provided in-depth insight into the fulfilment and frustration of basic needs, how meaning in life was perceived and physical activity. This point focuses more on how this question was asked and how the results are related to the question, rather than the combination of the quantitative data and qualitative data illustrated as the first strength. The extensive formulation stimulated the participants to tell as much as possible about different aspects of their lives. Various subjects were addressed, such as work performance, family relationships, living abroad, and coping with mental and physical health problems. The richness in the 271 responses can also be depicted by the number of codes (645) and the average length of the answers to the check-in question was 145 words. Nevertheless, this is only a general depiction and these numbers do not represent the actual variability within the responses. All in all, the open question provoked the participants to take

the time to write about their past experiences through an abundance of topics including basic psychological needs, meaning in life, and physical activity.

The third and final strength is the holistic approach including both psychological factors and physiological factors that influence mental health. While many studies examined the relationship between basic psychological needs and meaning in life, also many studies left out any physiological factor that can predict well-being (Lambert et al., 2013; Stillman et al., 2010; Zhang et al., 2022). Mahindru et al. (2023) stress the importance of including the physiological factors to increase well-being and explain which bodily mechanisms are involved in, for example, developing depressive and anxiety symptoms. Thus, incorporating physiological factors next to the psychological factors of mental health is equally important to foster well-being and this combination will stimulate other studies to do the same.

### **Recommendation for Future Research**

Next to the limitations, there are other recommendations for future research. The first recommendation to improve this research further pertains to the measurement of physical activity because there is a strong recommendation for using a standardised questionnaire. A suggestion for future research could be not only including the frequency of the physical activity, but also the intensity, time, and type. This would lead to a more holistic approach to physical activity according to Burnet et al. (2020). They found that frequency, intensity, time, and type (FITT) are important factors in defining and optimising adherence to physical activity (Morris, 2024). So, a standardised test to measure physical activity is highly recommended to ensure the representativeness, that is, validation and reliability of the variable.

A second recommendation is that there could be research done on the separate constructs of basic psychological needs, the constructs of meaning in life, and possible physical activity (measured by FITT). In this way, there is a more nuanced relationship depicted between basic psychological needs and meaning in life. Existing studies have tried to address these

separate concepts of basic psychological needs, for instance, Martela et al. (2017) measured meaning in life with the Presence of Meaning Scale which measures the presence of meaning and search for meaning. Another example is that of Marwa and Xiaosong (2023), who also used this scale to measure meaning in life. In addition to this, basic needs are not always approached with both satisfaction and frustration, an illustration of this is Eakman (2013), this study utilises the Basic Psychological Needs Scale. This scale measures only whether to what extent the needs are satisfied, leaving out the frustration of these needs. In brief, there is a strong recommendation to assess the relationship between basic psychological needs and meaning in life with the use of the BPNSFS and 3DM to measure as concisely as possible.

A third recommendation is to investigate whether age influences the relationship between basic psychological needs and meaning in life. Existing literature suggests that meaning in life is among other things dependent on age (Derkx et al., 2019; Ju, 2017; Shoshani, 2024). For example, Ju (2017) conducted a study which found that vitality in older adults who are not able to participate physically can be increased by a strong meaning in life. In line with this, Derkx et al. (2019) found that the sense of meaning could be different in older adults due to the stage of life, for instance, more losses of family and friends. To support this even more, self-report and parental reports about meaning in life were positively correlated with the age of children ranging from three to six (Shoshani, 2024). Thus, based on this, it could be interesting how the relationship between basic psychological needs and meaning in life changes over time.

## **Conclusion**

In conclusion, it was found that basic psychological needs predict meaning in life and that the satisfaction of these needs concerning meaning in life is positively affected by a highly frequent physical activity environment compared to an environment in which physical activity is perceived as low. This study promotes harmonious lifestyles by combining psychological as

well as physiological predictors of well-being to prevent and foster mental health, also considering physical activity concerning the self-determination theory.

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## Appendix A

### Application study

Thank you for your interest in participating in our study about mental wellbeing throughout the life span. We need some basic information from you before we can send the surveys to your email address and make your application official. Please note that you can withdraw at any time during the study and that we treat your data with great confidentiality according to the Ethical guidelines for conducting scientific research.

What is your age (in years)?

---

How do you describe yourself?

Female

Male

Non-binary

Prefer to self-describe: \_\_\_\_\_

Prefer not to say

What is the highest level of school you have completed?

Primary school

Secondary school (high school or equivalent including GED)

Vocational secondary education

Bachelor in (applied) sciences

Master in (applied) sciences, or PhD

What is your current marital status?

Married or registered partnership

Divorced/seperated

Widowed

Never been married

What is your current living situation? If you live in a student home but you have your own room, fill in "living alone".

Living alone

- Living with partner
- Living with partner and children
- Living with children
- Living with my parent(s)
- Living with others

What best describes your current employment status?

- Working full-time
- Working part-time
- Unemployed and looking for work
- A homemaker or stay-at-home parent
- Student
- Retired
- Other, namely \_\_\_\_\_

What is your nationality?

- Dutch
- German
- Belgian
- Turkish
- Moroccan
- Other, namely \_\_\_\_\_

## Appendix B

**Table 1A**

*Regression coefficients for the interactive effect of physical activity on basic psychological needs and meaning in life.*

Model 2.1	Estimate	SE	95% CI		<i>p</i>
			<i>LL</i>	<i>UL</i>	
Intercept	-0.72	0.53	-1.77	0.32	.173
Basic Psychological Needs Satisfaction	0.74	0.07	0.61	0.88	< .001 ***
Physical Activity	1.65	0.65	0.37	2.93	.012 *
Interaction	-0.18	0.08	-0.34	-0.01	.034 *
Model 2.2	Estimate	SE	95% CI		<i>p</i>
			<i>LL</i>	<i>UL</i>	
Intercept	6.98	0.31	6.38	7.59	< .001***
Basic Psychological Needs Frustration	-0.41	0.06	-0.53	-0.30	<.001***
Physical Activity	0.02	0.37	-0.70	0.74	.967
Interaction	0.04	0.08	-0.11	0.18	.628

*Note.* *N* = 271. *CI* = confidence interval; *LL* = lower limit; *UL* = upper limit.

\**p* < .05. \*\**p* < .01. \*\*\**p* < .001.