



# What Drives Mating Effort: Fear of Singlehood, Relationship Status, and Self-Esteem

Menelaos Apostolou<sup>1</sup> · Burcu Tekeş<sup>2</sup> · Antonios Kagialis<sup>3</sup>

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## Abstract

**Purpose** Attracting and maintaining a romantic partner requires considerable effort. In the current study, we aimed to test the hypothesis that fear of singlehood is a primary factor driving individuals to allocate scarce resources in the mating domain.

**Methods** We conducted a close-ended survey with a sample of 990 Greek and Turkish-speaking participants.

**Results** We found that that a stronger fear of singlehood was associated with higher mating effort. Moreover, voluntarily single participants experienced lower fear of singlehood compared to other categories of singles and individuals in intimate relationships. Additionally, higher self-esteem was associated with lower fear of singlehood. We also identified a significant indirect effect of relationship status and self-esteem on mating effort through fear of singlehood. Specifically, involuntarily single individuals tended to exert more mating effort due to heightened fear of singlehood compared to those in other relationship status categories. Furthermore, higher self-esteem was associated with reduced mating effort, as it was associated with lower fear of singlehood. These findings held true across both the Greek and Turkish samples.

**Conclusion** Relationship status and self-esteem play a role in mating effort through fear of singlehood.

**Keywords** Fear of Singlehood · Mating Effort · Self-esteem · Relationship Status

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✉ Menelaos Apostolou  
m.apostolou@gmail.com

<sup>1</sup> Department of Social Sciences, University of Nicosia, 46 Makedonitissas Ave, Nicosia 1700, Cyprus

<sup>2</sup> Department of Psychology, Başkent University, Bağlıca Kampüsü, Ankara, Turkey

<sup>3</sup> Department of Psychiatry, School of Medicine, University of Crete, Heraklion, Crete, Greece

## Introduction

Forming lasting intimate relationships is a universal human experience (Coontz, 2006; Fisher, 2017). However, succeeding in this endeavor requires significant mating effort, involving the allocation of resources such as time and money to attract and maintain potential partners (Davis & Arnocky, 2022; Schmitt & Buss, 1996). This prompts the question: What motivates people to invest the necessary effort in pursuit of this goal? In our current research, we propose that fear of singlehood—defined as concern, anxiety, or distress related to the current or anticipated state of being without a romantic partner (Spielmann et al., 2013)—is one such motivating factor. We aim to explore whether this fear drives people to exert greater mating effort to avoid remaining single. Research on mating effort has predominantly focused on short-term mating (for an accessible summary of the relevant literature, see Buss, 2016). Conversely, the present research focuses on long-term mating. Therefore, when we refer to ‘mating effort’, we do so within the context of long-term relationships. To build our argument, we will begin by discussing the evolutionary significance of intimate relationships.

## Mating and Mating Effort

Humans are a sexually reproducing species, which means that individuals need to gain sexual access to members of the opposite sex in order to produce offspring. Nevertheless, sexual intercourse alone is often insufficient because human children require significant, reliable, and prolonged parental investment to reach sexual maturity and eventually have children of their own (Hawkes et al., 1989; Kim et al., 2012). For a single parent, providing such investment can be challenging, underscoring the essential cooperation between parents in raising children (Lancaster & Lancaster, 1987). Thus, attracting and maintaining an intimate partner holds critical evolutionary importance. In other words, those who failed to do so faced significant reproductive disadvantages, ultimately not becoming our ancestors (Buss, 2016).

Yet, establishing and sustaining an intimate relationship require considerable effort. To begin, the mating process is highly competitive, leading mate-seekers to allocate substantial resources toward developing and demonstrating desirable traits (Schmitt & Buss, 1996). For instance, people invest money and time in actions aimed at enhancing their appearance, such as engaging in physical exercise, dieting, purchasing expensive clothing, applying makeup, and even undergoing plastic surgery (Apostolou et al., 2023; Shomaker & Furman, 2010). Additionally, individuals must allocate time and resources to locate desirable mates, which may involve going out to bars, clubs, expanding their social circle, and utilizing online dating platforms (Apostolou & Prodromou, 2023). Furthermore, the mating market is rife with deception, as mate-seekers often try to misrepresent their qualities and intentions to prospective partners (Haselton et al., 2005). Consequently, effort is essential for effectively screening potential mates in these domains.

Attracting mates is not the end of the story, as considerable effort is also required in keeping them. In more detail, people have several expectations from their intimate partners, including exclusivity, emotional support, material support, and a good

sexual life, and they may end the relationship or cheat if these expectations are not met (De Graaf & Kalmijn, 2006; Hawkins et al., 2012). Satisfying a partner's expectations would inevitably require allocating resources including time and money. Furthermore, individuals employ several strategies for attracting someone else's partner (Schmitt & Buss, 2001); thus, people need to allocate effort in order to guard their intimate partners (Buss, 2002).

Overall, attracting and keeping mates requires committing resources that would favor the evolution of mechanisms that would enable people to make the effort required to achieve this goal. We argue that emotions are key such mechanisms. In particular, these mechanisms monitor life events and generate positive or pleasant-to-experience emotions when individuals perform actions or find themselves in situations that increase their survival and reproductive success, termed fitness, and negative or unpleasant-to-experience ones, when individuals perform actions or find themselves in situations that decrease their fitness (Nesse, 2019; Tooby & Cosmides, 2008). In this way, people are motivated to engage in actions that lead them to avoid fitness-decreasing and engage in fitness-increasing situations (for a more thorough discussion of the different functions of emotions see Tooby & Cosmides, 2008). In terms of mating, people who are single experience negative emotions such as loneliness and sadness that motivate them to take action in order to secure mates (Apostolou et al., 2019).

Since singlehood can potentially compromise one's fitness, it triggers emotions that motivate seeking a partner. We propose that one path leading to such action is the following: Singlehood is associated with negative emotions including loneliness and sadness that would create a fear of it, which in turn, would motivate people to exercise the necessary effort in order to avoid being single. Simply put, people would fear being single as it is potentially associated with negative emotions, and this fear would motivate them to make the effort necessary to avoid it. Furthermore, not all individuals need to exert the same effort to attract and retain mates. For instance, some people may have traits that are considered highly desirable in a mate, and thus, they may need to allocate less mating effort to secure a mate than those who lack such traits. Accordingly, we propose that fear of singlehood would adjust to factors that indicate how much mating effort an individual needs to make to attract and retain an intimate partner. If a given factor indicates that the individual does not need to exert much effort, the fear would decrease and so would the mating effort. Conversely, if a given factor indicates that the individual needs to exercise more mating effort, the fear of singlehood would increase, and so would the mating effort. This hypothesis generates testable predictions that we will examine next. Before doing so, we will discuss first sex differences in mating effort.

### Sex Differences in Mating Effort

Mating effort is a multifaceted phenomenon encompassing all efforts that people allocate in gaining access to mates (see for instance, Brazil et al., 2023 for research on mating effort and coercion). One such facet is effort directed at acquiring a variety of casual sex partners (Buss & Schmitt, 1993). Men, due to not having to bear the burden of pregnancy, can potentially benefit more from having sex with many dif-

ferent mates (Buss & Schmitt, 1993). This is why we expect men to allocate more effort than women in getting a variety of casual sex partners (Buss, 2016). The present research focuses on mating effort to secure and retain long-term intimate partners rather than casual sex partners. In particular, we use an instrument developed to measure the effort that people allocate in attracting mates when single and retaining mates when in a relationship (Apostolou et al., 2018). This instrument contrasts with others that focus on the number of mates an individual has or wants to have sex with in a given time period (Buss & Schmitt, 1993). When it comes to long-term mating, the two sexes are more similar than different (Buss, 2016), and we do not have any additional reasons to anticipate sex differences in the relationships predicted above. Yet, in our analysis, we will still examine if there are sex differences in the variables of interest.

### Fear of Singlehood and Mating Effort

The first prediction we can derive from the above theoretical perspective is that a stronger fear of singlehood would be associated with higher mating effort ( $H_1$ ). Therefore, mating effort is influenced by fear of singlehood, which itself adjusts based on factors that indicate how much effort an individual needs to exert to attract and retain a mate. We propose that relationship status is one such factor. More specifically, it is reasonable to argue that more mating effort is required to escape singlehood than to maintain a relationship. Thus, we expect single people to experience stronger fear of singlehood, enabling them to adjust their mating effort accordingly.

Yet, in some instances, being single could actually promote people's reproductive success. Traits such as education, a good job, high social status, and good looks are highly valued in the mating market (Buss, 2016; Thomas et al., 2020), but require considerable resources such as time and money to develop. These resources are also required for attracting and keeping mates. Therefore, it could be beneficial for people to temporarily opt out of the mating market and focus on increasing their mate value by developing their strengths. They could then return to the market at a later point with better chances of securing a desirable partner (Apostolou et al., 2020). Similarly, unforeseen circumstances like illness or unemployment can pose more immediate threats to fitness than failing to secure a mate. Accordingly, it may be beneficial for people to focus their energy on resolving these issues before committing to finding a romantic partner.

For such different reasons, people may choose to be single (Apostolou et al., 2020). If people are to remain single for some time, their fear of singlehood needs to subside, leading to the prediction that voluntarily single individuals would experience lower fear of singlehood than involuntarily singles, who still need to secure a mate and likely experience more fear than those already in a relationship ( $H_2$ ). Given this, relationship status would have an effect on mating effort through fear of singlehood. In particular, involuntarily single individuals would experience more fear of singlehood that will drive them to exert more mating effort than voluntarily single individuals, and people in an intimate relationship ( $H_3$ ).

Moreover, as discussed above, there are traits that are highly desirable in the mating market, *ceteris paribus*, individuals who score high in them may need to exer-

cise less effort than people who score low. Thus, mating effort needs to adjust to these traits, and we propose that this happens through self-esteem, defined as one's perceived worthiness as a person (Baumeister, 1993). More specifically, it has been argued that self-esteem constitutes an evolved mechanism providing individuals with adaptively relevant feedback about their position in the social world (Kenrick et al., 2010; Leary, 1999; Schmitt & Jonason, 2019). As such, self-esteem would respond to these traits, with higher scorers enjoying higher self-esteem. People higher in self-esteem are likely to perceive themselves as more capable of dealing with the challenges of singlehood, finding it easier to secure a mate if they find themselves without one, and more likely to keep one when they are in a relationship. It follows that higher self-esteem would be associated with lower fear of singlehood ( $H_4$ ). In turn, people who experience higher self-esteem would exercise lower mating effort due to experiencing lower fear of singlehood ( $H_5$ ). Related to this prediction, Borráz-León et al. (2023) found positive associations between self-perceived attractiveness, self-reported health, psychological flexibility, and mating effort, which shows that mating effort may be, in fact, linked to physical and psychological traits related to attractiveness and potentially to self-esteem as well.

## Methods

### Participants

The study was conducted at a private university in the Republic of Cyprus and a private university in Turkey. For the Turkish sample, we employed data from a larger study on human mating (Apostolou & Tekeş, 2023) focusing on variables that had not been analyzed before. For the Greek sample, we designed a study specifically for the present research, which included the variables of interest that were also part of the larger Turkish study. The only inclusion criterion was for participants to be at least 18 years old. To improve the quality of our data, we excluded from the analysis responses that were more than 30% incomplete.

The pooled sample included 990 participants (568 women, 412 men, six participants who indicated their sex as 'other,' and four who did not indicate their sex). The mean age of women was 33.4 ( $SD=11.4$ , Range=57, Skewness=0.89, Kurtosis=0.41), and the mean age of men was 34.8 ( $SD=11.6$ , Range=63, Skewness=0.77, Kurtosis=0.11). Moreover, 25.9% of the participants reported being in a relationship, 20.1% were involuntarily single, 19.3% were married, 18.7% were between relationships, 12.0% indicated being voluntarily single, and 4.0% chose to classify their relationship status as 'other'.

For the Turkish sample, the study run online and the link was shared with friends, colleagues, family, and through social media by student research assistants who received course credit in return. A total of 453 Turkish-speaking participants took part, including 290 women, 162 men, and one participant who indicated their sex as 'other'. The mean age of women was 31.6 ( $SD=11.3$ , Range=57, Skewness=0.95, Kurtosis=0.53), and the mean age of men was 32.3 ( $SD=13.0$ , Range=63, Skewness=0.91, Kurtosis=1.19). Furthermore, 32.1% of the participants reported being in

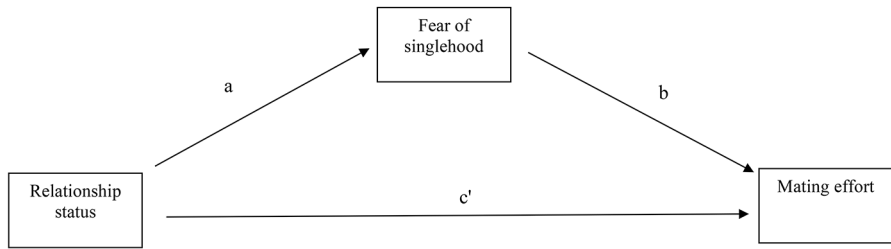
a relationship, 27.8% were married, 17.0% indicated being voluntarily single, 10.6% were between relationships, 9.3% were involuntarily single, and 3.3% chose to classify their relationship status as ‘other’.

The Greek sample was recruited by forwarding the link of the study to students, and by advertising it in social media, namely Facebook and Instagram. In total, 537 Greek-speaking participants took part (278 women, 250 men, five participants who indicated their sex as ‘other,’ and four who did not indicate their sex). The mean age of women was 35.3 ( $SD=11.3$ , Range=57, Skewness=0.80, Kurtosis=0.53) and the mean age of men was 36.4 ( $SD=10.3$ , Range=42, Skewness=0.44, Kurtosis=0.70). Additionally, 29.2% of the participants were involuntarily single, 25.5% were between relationships, 20.7% in a relationship, 12.1% married, 7.8% voluntarily single, and 4.7% indicated their relationship status as ‘other.’

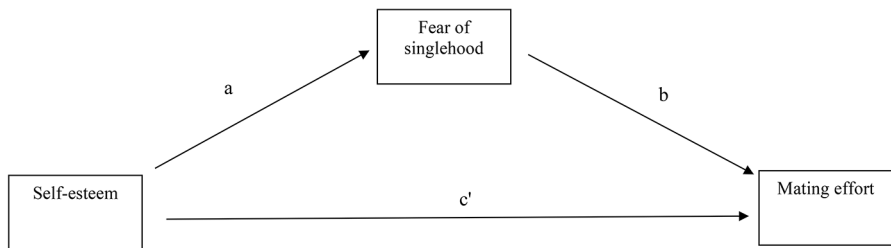
## Materials

For the Greek sample, the questionnaire was in Greek, and for the Turkish sample, it was in Turkish. Both versions of the questionnaire were designed using Google Forms. Spielmann et al. (2013) developed a six-item instrument to measure fear of singlehood. However, several of the items used, such as “I need to find a partner before I’m too old to have and raise children,” and “As I get older, it will get harder and harder to find someone,” fit better for participants who were single. As our research also included participants who were in an intimate relationship, we constructed a different instrument that could be better applied to our research objectives. In total, we employed two items from Spielmann et al. (2013), namely, “If I end up alone in life, I will probably feel like there is something wrong with me,” and “I feel anxious when I think about being single forever,” and we added three more items, namely, “Loneliness scares me,” “It scares me not to have an intimate partner by my side,” and “It scares me to be single.” Participants were asked to rate each of the items using the following scale: 1 - Strongly disagree, 5 - Strongly agree. In order to examine whether our instrument could be divided into subscales, we performed a principal components analysis using direct oblimin as a rotation method. The results produced a one-factor solution, indicating that no subscales were present. Cronbach’s alpha for this instrument was 0.87 for the pooled as well as for the Greek and Turkish samples. Additionally, McDonald’s omega was 0.87 for the pooled sample, 0.87 for the Greek sample, and 0.88 for the Turkish sample.

Mating effort was measured using a four items instrument developed by Apostolou et al. (2018), which included questions such as “I dedicate all my energy to my romantic relationships.” Participants’ responses were recorded in a five-point scale (1-strongly disagree, 5- strongly agree), and were scored so that a higher score indicated a higher performance in mating. Cronbach’s alpha was 0.75 for the pooled sample, 0.78 for the Greek sample, and 0.70 for the Turkish sample. In addition, McDonald’s omega was 0.77 for the pooled sample, 0.79 for the Greek sample, and 0.71 for the Turkish sample. Furthermore, self-esteem was measured using the Rosenberg Self-Esteem Scale, which consisted of 10 items (Rosenberg, 1965). The instrument included items such as “I feel I do not have much to be proud of.” A higher mean score indicated higher self-esteem. Cronbach’s alpha was 0.88 for the pooled as



**Fig. 1** The figure above depicts the direct and indirect effect of relationship status on mating effort



**Fig. 2** The figure above depicts the direct and indirect effect of self-esteem on mating performance

well as for the individual samples. Additionally, McDonald's omega was 0.89 for the pooled sample, 0.91 for the Greek sample, and 0.86 for the Turkish sample.

Demographic information, including biological sex, age, and relationship status were also recorded. Relationship status was measured using a previously established instrument (Apostolou & Wang, 2019), which included the following categories: "In a relationship," "Married," "Involuntarily single: I want to be in a relationship, but I find it difficult to attract a mate," "Single between-relationships: My relationship has recently ended and I have not yet found another partner," "Prefer to be single: I am not interested in being in a relationship," and "Other."

## Data Analysis

In order to examine the effect of fear of singlehood on mating effort, we performed an ANCOVA test, where mating effort entered as the dependent variable, fear of singlehood as the independent continuous variable, and self-esteem, age, sex, relationship status, and sample as covariates. In order to examine the effect of relationship status and self-esteem on fear of singlehood, we also run an ANCOVA test where fear of singlehood entered as the dependent variable, self-esteem entered as a continuous independent variable, relationship status entered as a categorical independent variable, and age, sex, and sample entered as covariates. The two ANCOVA tests were performed on the pooled sample, and individually on the Greek and Turkish samples.

In order to examine the indirect effect of relationship status and self-esteem on mating effort, we performed mediation analysis as depicted in Figs. 1 and 2. In this

analysis, age, sex, and sample entered as covariates. Note that our hypothesis is that relationship status or self-esteem affect fear of singlehood that in turn affects people's mating effort. This describes the process through which our variables are related, making mediation more appropriate than moderation analysis. Mediation analysis was performed on the pooled sample, as well as on individual samples. Unstandardized indirect effects were calculated for each of the 10,000 bootstrapped samples, and the 95% confidence interval was determined by examining the indirect effects at the 2.5th and 97.5th percentiles. The statistical analysis was performed using SPSS version 28 and the PROCESS macro version 4.2.

## Results

### Preliminary Analysis

To assess normality of our continuous variables (i.e., age, mating effort, self-esteem, fear of singlehood), we conducted a preliminary analysis using p-p plots. While p-p plots analysis suggested normal distribution for most continuous variables (mating effort, self-esteem, fear of singlehood), there was some deviation for age. Skewness values supported this conclusion, with a value of 0.83 for age, and values close to zero for mating effort (-0.03), self-esteem (-0.02), and fear of singlehood (-0.02). We also examined correlations between these variables (see Appendix A). No correlations were strong enough to raise concerns about multicollinearity.

### Higher Fear of Singlehood would be Associated with Higher Mating Effort ( $H_1$ )

From Table 1 we can see that, for the pooled sample, there was a significant main effect of fear of singlehood on mating effort. The effect was moderate to large in size, and positive meaning that higher fear of singlehood was associated with higher mating effort. We can also see that there was no significant interaction between fear of singlehood and sex, indicating that the effect of the former on mating effort does not depend on the level of the latter. Self-esteem had also a positive but small effect on mating effort. Similar effects were observed in both the Greek and Turkish samples (Appendix B).

**Table 1** The effects of fear of singlehood, and self-esteem on mating effort for the pooled sample

Predictors	<i>p</i> -value	$\eta_p^2$	<i>b</i>
Fear of singlehood	<0.001	0.082	0.219
Self-esteem	<0.001	0.023	0.168
Age	0.129	0.002	-0.004
Sex	0.762	0.000	-
Relationship status	<0.001	0.099	-
Sample	<0.001	0.030	-
Fear of singlehood * Sex	0.716	0.000	-
Self-esteem*sex	0.303	0.001	-

Note. The adjusted R Squared for this analysis was 0.237



**Table 2** The effects of relationship status and self-esteem on fear of singlehood for the pooled sample

Predictors	<i>p</i> -value	$\eta_p^2$	<i>b</i>
Self-esteem	<0.001	0.082	−0.571
Age	0.521	0.000	−0.002
Sex	0.725	0.000	-
Relationship status	<0.001	0.061	-
Sample	0.294	0.001	-
Self-esteem*sex	0.987	0.000	-

Note. The adjusted R Squared for this analysis was 0.160

**Table 3** Differences in mean scores of fear of singlehood between levels of the relationship status

	Relationship status					
	Involuntarily single	Voluntarily single	Between relationships	In a relationship	Married	Other
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Pooled	3.31 (1.01)	2.30 (0.99)*	3.27 (1.07)	2.93 (1.10)	2.77 (1.08)	2.84 (0.85)
Greek	3.30 (1.00)	2.24 (0.86)*	3.31 (1.05)	3.04 (1.03)	2.87 (1.11)	2.82 (0.86)
Turkish	3.32 (1.03)	2.33 (1.06)*	3.13 (1.14)	2.85 (1.14)	2.71 (1.06)	2.88 (0.85)

\* indicates significant difference from involuntary single

### Relationship Status would be Associated with fear of Singlehood (H<sub>2</sub>)

From Table 2, we can see that, for the pooled sample, there was a significant and moderate in size main effect of relationship status on fear of singlehood. From Table 3 we can see that the highest mean was for the involuntarily single group, followed by the between-singles group, while the lowest was for the voluntarily single group. Post-hoc analysis indicated that the voluntarily single group was significantly different from all other groups that were not however significantly different from each other. This was the case when the analysis was performed separately on the Greek and the Turkish samples. We can observe further that the effect of the relationship status was higher in Greek than in the Turkish sample, and that in the Greek sample, the mean scores of the involuntary and between-relationships singles were more similar than in the Turkish sample (Appendix C).

### Higher Self-Esteem would be Associated with Lower Fear of Singlehood (H<sub>4</sub>)

From Table 2, we can see that, for the pooled sample, there was a significant main effect of self-esteem on fear of singlehood. The coefficient was negative, indicating that higher scores in self-esteem were associated with lower scores in the fear of singlehood variable. Partial eta squared indicated that the effect was moderate to large. This effect was observed in both the Greek and the Turkish samples, but it was more pronounced in the former (Appendix C). We can also see that there was no significant interaction between self-esteem and sex, indicating that the effect of the former on fear of singlehood does not depend on the level of the latter.

### **Involuntarily Singles would Experience More Fear of Singlehood that will Drive them to More mating Effort than voluntarily Singles, and People in an Intimate relationship (H<sub>3</sub>)**

When mediation analysis is performed with a multicategorical independent variable (here, relationship status), one level is used as a reference category (here, the involuntarily single) and coefficients are estimated for the rest of the levels of the independent variable, which are interpreted in relation to the reference category. From Table 4, we can see that for the pooled sample, with the exception of the “between-relationships single” group, for the remaining groups there was a significant effect on fear of singlehood with a negative coefficient. For instance, for the married group, the coefficient was  $-0.299$ , indicating that being married, compared to being involuntarily single, was associated with a decrease of 0.299 units in fear of singlehood. Given that fear of singlehood was measured on a five-unit scale, this effect could be interpreted to be considerable. There was also a significant effect of fear of singlehood on mating effort with a positive coefficient (0.211), indicating that higher fear of singlehood was associated with more mating effort.

With respect to the indirect effects, for the pooled sample, with the exception of the “between-relationships single,” all other indirect effects were significant with a negative coefficient. To use one example, there was a significant indirect effect of the “in a relationship” level of the relationship status variable with a coefficient equal to  $-0.06$ . This indicates that being in a relationship, compared to being involuntarily single, was associated with a decrease of 0.06 units in mating effort, through the mediation of fear of singlehood. Simply put, being in a relationship was associated with a decrease in fear of singlehood, which in turn was associated with a decrease in mating effort. Overall, these findings indicate that participants who reported their relationship status as voluntarily single, in a relationship, married, or “other” experienced lower fear of singlehood that led them to allocate less mating effort than participants who indicated their relationship status as involuntarily single. For the “in a relationship” and “married” groups, the coefficients were small, indicating a small indirect effect. For the Greek sample, the indirect effects of the “in a relationship” and “married” groups were in the predicted direction and approached but did not pass the significance level. For the Turkish sample, with the exception of the “voluntarily single” and the “other” groups, all other indirect effects were significant and with a negative coefficient.

### **People Who Experience Higher Self-Esteem would Exercise Lower Mating Effort Due to Experiencing Lower Fear of Singlehood (H<sub>5</sub>)**

From Table 5 we can see that, for the pooled sample, there was a direct effect of self-esteem on mating effort with a positive coefficient, indicating that higher self-esteem was associated with higher mating effort. This was also the case for the Greek sample, while for the Turkish sample, the coefficient was also positive, and approached but it did not pass the significance level. Moreover, we can see that for the pooled as well as the individual samples, there was a significant effect of self-esteem on fear of singlehood, and a significant effect of fear of singlehood on mating effort. Thus, there

**Table 4** Direct and indirect effects of relationship status on mating effort

	Relationship status on mating effort (c')	Relationship status on fear of singlehood (a)	Fear of singlehood on mating effort (b)	Relationship status * fear of singlehood (a*b)	R-squared
Poolled			0.211** (0.166–0.256)		0.178
Voluntarily single	-0.662* (-0.839 - -0.486)	-0.868** (-1.113 - -0.623)		-0.183* (-0.251 - -0.124)	
Between-relationships	0.045 (-0.101–0.192)	0.002 (-0.207–0.211)		0.000 (-0.043–0.043)	
In a relationship	0.137 (-0.003–0.278)	-0.291* (-0.490 - -0.092)		-0.061* (-0.106 - -0.020)	
Married	-0.021 (-0.183–0.141)	-0.299** (-0.529 - -0.070)		-0.063* (-0.115 - -0.014)	
Other	-0.237 (-0.489–0.014)	-0.375* (-0.732 - -0.018)		-0.079* (-0.149 - -0.016)	
Greek			0.218** (0.152–0.284)		0.190
Voluntarily single	-0.741** (-1.005 - -0.477)	-1.035** (-1.378 - -0.693)		-0.226* (-0.330 - -0.137)	
Between-relationships	0.017 (-0.154–0.188)	0.057 (-0.173–0.286)		0.012 (-0.039–0.065)	
In a relationship	0.016 (-0.167–0.199)	-0.187 (-0.432–0.057)		-0.041 (-0.102–0.014)	
Married	-0.011 (-0.232–0.211)	-0.190 (-0.487–0.107)		-0.041 (-0.116–0.030)	
Other	-0.373* (-0.698 - -0.047)	-0.443* (-0.879–0.001)		-0.097* (-0.186 - -0.016)	
Turkish			0.212* (0.149–0.274)		0.172
Voluntarily single	-0.507** (-0.780–0.235)	-0.840** (-1.247 - -0.433)		-0.178* (-0.280 - -0.090)	
Between-relationships	0.109 (-0.188–0.405)	-0.112 (-0.564–0.339)		-0.024 (-0.122–0.070)	
In a relationship	0.284* (0.040–0.529)	-0.361 (-0.731–0.009)		-0.076* (-0.157–0.005)	
Married	0.096 (-0.174–0.366)	-0.440* (-0.848–0.031)		-0.093* (-0.183–0.011)	
Other	-0.024 (-0.437–0.389)	-0.234 (-0.861–0.394)		0.049 (-0.170–0.065)	

Note. The reference category is the "Involuntarily single."

was also a significant indirect effect of self-esteem on mating effort through fear of singlehood. In all cases, this effect came with a negative coefficient, indicating that higher self-esteem was associated with less mating effort by being associated with lower fear of singlehood. For instance, for the pooled sample, one unit increase in self-esteem was associated with 0.16 points decrease in mating effort by being associated with lower fear of singlehood.

## Discussion

In the present research, we found that a stronger fear of singlehood was associated with higher mating effort. We also found that fear of singlehood was associated with relationship status and self-esteem. In particular, voluntarily single participants experienced lower fear of singlehood than other singles or those in an intimate relationship. Moreover, higher self-esteem was associated with lower fear of singlehood. We further examined whether relationship status and self-esteem indirectly influenced mating effort by being associated with fear of singlehood. We found that involuntarily single individuals tended to exert more mating effort due to experiencing more fear of singlehood compared to people in other relationship categories. Higher self-esteem, on the other hand, was associated with lower mating effort, mediated by lower fear of singlehood. These findings were consistent across both Greek and Turkish samples.

In accordance with our original prediction, fear of singlehood emerged as a main predictor of mating effort, with higher fear linked to greater effort. The effect size was moderate to large, indicating that this fear influences substantially how much effort individuals invest in mating. This supports the evolutionary function of fear (see de Becker, 2021): Motivating people to take action to avoid unfavorable situations, in this case, singlehood. Still, singlehood may have positive effects in certain cases. Voluntarily single individuals reported lower fear of singlehood than other types of singles and those in an intimate relationship. However, our prediction regarding voluntarily single individuals' fear of singlehood compared to mated participants was not supported, as they actually reported lower fear. Additionally, our prediction that involuntarily single participants would experience more fear of singlehood than mated participants was only partially supported: While the means were in the predicted direction in all instances, none of the differences reached statistical significance.

On the other hand, as we originally predicted, higher self-esteem was associated with lower fear of singlehood. This prediction was based on the argument that self-esteem constitutes an evolved mechanism that provides individuals with adaptively relevant feedback about their position in the social world (Kenrick et al., 2010; Leary, 1999). Accordingly, our interpretation of the observed association is that people with more desirable qualities experience higher self-esteem, making them feel confident about keeping an existing partner or attracting a new one if single, leading to less fear of being single. Future research could test this hypothesis by examining whether desirable traits like high social status and good looks indirectly predict fear of singlehood through self-esteem.

**Table 5** Direct and indirect effects self-esteem on mating effort

	Self-esteem on mating effort (c')	Self-esteem on fear of singlehood (a)	Fear of singlehood on mating effort (b)	Self-esteem * fear of singlehood (a*b)	R-squared
Pooled	0.207** (0.082–0.331)	-0.621** (-0.787 - -0.455)	0.259** (0.198–0.319)	-0.161** (-0.225 - -0.105 )	0.170
Greek	0.253** (0.089–0.418)	-0.613** (-0.823 - -0.402)	0.275** (0.189–0.361)	-0.168** (-0.259 - -0.095)	0.124
Turkish	0.113 (-0.076–0.301)	-0.595** (-0.866 - -0.323)	0.247** (0.163–0.330)	-0.147** (-0.238 - -0.069)	0.179

As discussed earlier, mating effort should adjust to the resources needed to achieve the desired goal. From an evolutionary standpoint, it would not be optimal to expend excessive time and energy on an easily attainable objective. Therefore, fear of singlehood, and ultimately mating effort, should adjust based on self-esteem, which reflects desirable traits. Consistent with this, we found a significant path where higher self-esteem was associated with lower fear of singlehood, which in turn was associated with lower mating effort. Interestingly, we also found a direct effect where higher self-esteem is associated with higher mating effort. Perhaps those with higher self-esteem invest more effort because they are confident it will be successful. These findings highlight the complex interplay of factors influencing mating effort.

We found no significant interaction between sex and fear of singlehood, suggesting it has a similar effect on motivating mating effort in both men and women. In other words, higher fear of singlehood is associated with a similar increase in mating effort regardless of sex. However, this quantitative similarity does not preclude qualitative differences. For example, research indicates that men may prioritize physical attractiveness in potential partners, while women prioritize social status (Buss, 2016; Thomas et al., 2020). Accordingly, it is possible that fear of singlehood drives women to invest more in appearance enhancement and men to focus on increasing social status. Moreover, our study found similar overall mating effort between men and women, likely because we focused on long-term relationships rather than casual mates. Nevertheless, fear of singlehood could be associated with both. People with lower fear might be less interested in forming lasting partnerships and seek casual mates to fulfill sexual needs. Future research should explore this connection.

Our main hypothesis derived from an evolutionary theoretical perspective was that emotional mechanisms would give rise to a fear of singlehood that would motivate mating effort; an argument that should be true across different cultural settings. Accordingly, the homogeneity of the results in the Greek and Turkish samples suggests that this is the case. Nevertheless, this similarity could also be due to the two countries exhibiting cultural similarities due to their geographical proximity and shared history (see Heraclides & Çakmak, 2019). Therefore, replication in more diverse cultural settings is necessary for establishing the universality of the observed effects.

We propose that negative emotions associated with singlehood, such as loneliness, contribute to the fear of singlehood. Simply put, people fear the negative emotions they might experience if single. Yet, Costello et al. (2022) suggest that for a small minority, these negative emotions might lead to rejecting relationships altogether,

minimizing mating effort. Further research is needed to explore the ontogeny of fear of singlehood in more detail. In the current study, we examined relationship status' and self-esteem's effects on fear of singlehood, but additional factors like past experiences with singlehood, life stage, and so on, likely play a role. Future studies should investigate these factors as well. Furthermore, singlehood can offer benefits like self-development opportunities, casual sex options, and increased freedom (Apostolou & Christoforou, 2022). The value of these benefits varies – for instance, some people may prioritize freedom more than others. Consequently, how someone perceives the benefits of singlehood could be associated with their fear of singlehood. For example, people who value freedom more might experience less fear than those who value it less. Future research should examine this potential association between perceived benefits of singlehood and fear of singlehood.

Moreover, in the current research, fear of singlehood had a beneficial consequence: It motivated people to exercise more mating effort, potentially helping them keep or attract a partner. Yet, as Spielmann et al. (2013) showed, it can also have negative effects, such as leading people to make unhealthy compromises to avoid singlehood. Future studies should delve deeper into the consequences of fear of singlehood. Intimate relationships also come with costs, including reduced freedom, imposed monogamy, potential for tension and conflict, and strong negative emotions, which are likely lead to fear of relationship commitment (Apostolou & Tekeş, 2023). Fear of commitment acts in opposition to fear of singlehood, potentially reducing mating effort. Future research should examine the interaction between these two fears.

This line of research has practical implications for therapists and counselors helping clients navigate the complexities of forming and maintaining relationships. For instance, they may identify that a high fear of singlehood leads clients to make unhealthy compromises, while a low fear of singlehood, perhaps due to inflated self-esteem, may lead to insufficient effort. Accordingly, mental health professionals can work on helping clients manage their fear of singlehood to improve their success in intimate relationships.

One limitation of the present work is that it relied on self-report instruments, which can be susceptible to social desirability bias, meaning participants may provide answers they believe are socially acceptable. Additionally, our correlational design means causality cannot be established. Furthermore, our non-probability samples limit the generalizability of findings to the broader population. Also, participants for the Turkish sample were recruited through snowball sampling. This method may lead to the issue of non-independence: The responses of friends, colleagues, and family members might be more similar to each other than to those of the rest of the sample. For the Greek sample, the link was promoted on social media, which could potentially also lead to non-independence. For example, individuals sharing the link to our study with their friends on social media, who are likely to be more similar to them than to those who are not their friends. Moreover, the physiological underpinnings of mating effort and fear of singlehood remain unexplored. Future studies should address this gap in knowledge.

In conclusion, the current research suggests that fear of singlehood motivates mating effort to attract and retain partners. Consistent with this, we found a positive association between fear of singlehood and mating effort in both Greek and Turkish

samples. However, much work remains to identify the factors that predict fear of singlehood and ultimately, mating effort.

## Appendix A

Correlation matrix for the continuous variables in the study.

	Fear of singlehood	Self-esteem	Mating effort	Age
Fear of singlehood	1	-0.322**	0.321**	-0.047
Self-esteem	-0.322**	1	0.006	0.177**
Mating effort	0.321**	0.006	1	0.007
Age	-0.047	0.177**	0.007	1

\*\* Correlation is significant at the 0.01 level (two-tailed)

## Appendix B

The effects of fear of singlehood, and self-esteem on mating effort for the Greek sample.

Predictors	<i>p</i> -value	$\eta_p^2$	<i>b</i>
Fear of singlehood	<0.001	0.080	0.214
Self-esteem	<0.001	0.026	0.287
Age	0.759	0.000	-0.001
Sex	0.459	0.001	-
Relationship status	<0.001	0.075	-
Fear of singlehood * Sex	0.875	0.000	-
Self-esteem*sex	0.314	0.002	-

Note. The adjusted R Squared for this analysis was 0.174

The effects of fear of singlehood, and self-esteem on mating effort for the Turkish sample.

Predictors	<i>p</i> -value	$\eta_p^2$	<i>b</i>
Fear of singlehood	<0.001	0.088	0.223
Self-esteem	0.006	0.018	0.022
Age	0.140	0.005	-0.005
Sex	0.132	0.005	-
Relationship status	<0.001	0.123	-
Fear of singlehood * Sex	0.675	0.000	-
Self-esteem*sex	0.113	0.006	-

Note. The adjusted R Squared for this analysis was 0.244

## Appendix C

The effects of relationship status and self-esteem on fear of singlehood for the Greek sample.

Predictors	<i>p</i> -value	$\eta_p^2$	<i>b</i>
Self-esteem	<0.001	0.104	−0.666
Age	0.199	0.003	−0.005
Sex	0.392	0.002	-
Relationship status	<0.001	0.085	-
Self-esteem*sex	0.360	0.002	-

*Note.* The adjusted R Squared for this analysis was 0.178

The effects of relationship status and self-esteem on fear of singlehood for the Turkish sample.

Predictors	<i>p</i> -value	$\eta_p^2$	<i>b</i>
Self-esteem	<0.001	0.055	−0.489
Age	0.787	0.000	0.001
Sex	0.963	0.000	-
Relationship status	<0.001	0.049	-
Self-esteem*sex	0.699	0.000	-

*Note.* The adjusted R Squared for this analysis was 0.114

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## References

- Apostolou, M., & Christoforou, C. (2022). What makes single life attractive: An explorative examination of the advantages of singlehood. *Evolutionary Psychological Science*, 8, 403–412. <https://doi.org/10.1007/s40806-022-00340-1>
- Apostolou, M., O, J., & Esposito, G. (2020). Singles' reasons for being single: Empirical evidence from an evolutionary perspective. *Frontiers in Psychology*, 11., Article 746. <https://doi.org/10.3389/fpsyg.2020.00746>
- Apostolou, M., & Prodromou, A. (2023). Strategies for meeting prospective mates: An explorative analysis in the Greek cultural context. *Scandinavian Journal of Psychology*. <https://doi.org/10.1111/sjop.12975>
- Apostolou, M., & Tekeş, B. (2023). Fear of relationship commitment and singlehood. *Evolutionary Psychological Science*. <https://doi.org/10.1007/s40806-023-00382-z>
- Apostolou, M., & Wang, Y. (2019). The association between mating performance, marital status, and the length of singlehood: Evidence from Greece and China. *Evolutionary Psychology*. <https://doi.org/10.1177/1474704919887706>
- Apostolou, M., Shialos, M., Kyrou, E., Demetriou, A., & Papamichael, A. (2018). The challenge of starting and keeping a relationship: Prevalence rates and predictors of poor mating performance. *Personality and Individual Differences*, 122, 19–28. <https://doi.org/10.1016/j.paid.2017.10.004>
- Apostolou, M., Matogian, I., Koskeridou, G., Shialos, M., & Georgiadou, P. (2019). The price of singlehood: Assessing the impact of involuntary singlehood on emotions and life satisfaction. *Evolutionary Psychological Science*, 5, 416–425. <https://doi.org/10.1007/s40806-019-00199-9>
- Apostolou, M., Sullman, M., Birkás, B., Błachnio, A., Bushina, E., Calvo, F., Costello, W., Dujlovic, T., Hill, T., Lisun, Y., Manrique-Millones, D., Manrique-Pino, O., Meskó, N., Nechtelberger, M., Ohtsubo, Y., Ollhoff, C. K., Przepiórka, A., Putz, Á., Tagliabue, M., & Font-Mayolas, S. (2023). Strategies for becoming a more desirable mate: Evidence from 14 countries. *Personal Relationships*, 1–20. <https://doi.org/10.1111/perc.12521>
- Baumeister, R. F. (1993). *Self-esteem: The puzzle of low self-regard*. Plenum.
- Borráz-León, J. I., Krams, I. A., Cerda-Molina, A. L., & Rantala, M. J. (2023). Psychological flexibility and sociosexual orientation mediate the association between self-perceived attractiveness and mating effort. *Current Psychology*, 42, 31998–32007 (2023). <https://doi.org/10.1007/s12144-022-04155-y>
- Brazil, K. J., Vance, G., Zeigler-Hill, V., & Shackelford, T. K. (2023). Men's psychopathy and mating effort in intimate relationships: Links with jealousy and sexual coercion. *Archives of Sexual Behavior*, 52(6), 2421–2432. <https://doi.org/10.1007/s10508-023-02587-6>
- Buss, D. M. (2002). Human mate guarding. *Neuroendocrinology Letter Special Issue*, 23, 23–29.
- Buss, D. M. (2016). *The evolution of desire: Strategies of human mating* (4th ed.). Basic Books.
- Buss, D. M., & Schmitt, D. P. (1993). Sexual strategies theory: An evolutionary perspective on human mating. *Psychological Review*, 100(2), 204–232. <https://doi.org/10.1037/0033-295X.100.2.204>
- Coontz, S. (2006). *Marriage, a history: How love conquered marriage*. Penguin.
- Costello, W., Rolon, V., Thomas, A. G., & Schmitt, D. (2022). Levels of well-being among men who are incel (involuntarily celibate). *Evolutionary Psychological Science*, 8(4), 375–390. <https://doi.org/10.1007/s40806-022-00336-x>
- Davis, A. C., & Arnocky, S. (2022). An evolutionary perspective on appearance enhancement behavior. *Archives of Sexual Behavior*, 51, 3–37. <https://doi.org/10.1007/s10508-020-01745-4>
- de Becker, G. (2021). *The gift of fear*. Back Bay Books.
- De Graaf, P. M., & Kalmijn, M. (2006). Divorce motives in a period of rising divorce: Evidence from a Dutch life-history survey. *Journal of Family Issues*, 27, 483–505. <https://doi.org/10.1177/0192513X05283982>
- Fisher, H. (2017). *Anatomy of love: A natural history of mating, marriage, and why we stray*. Norton.
- Haselton, M., Buss, D. M., Oubaid, V., & Angleitner, A. (2005). Sex, lies, and strategic interference: The psychology of deception between the sexes. *Personality and Social Psychology Bulletin*, 31(1), 3–23. <https://doi.org/10.1177/0146167204271303>
- Hawkes, K., O'Connell, J. F., & Blurton Jones, N. G. (1989). Hardworking Hadza grandmothers. In V. Standen, & R. A. Foley (Eds.), *Comparative socioecology: The behavioural ecology of humans and other mammals* (pp. 341–366). Blackwell Scientific.

- Hawkins, A. J., Willoughby, B. J., & Doherty, W. J. (2012). Reasons for divorce and openness to marital reconciliation. *Journal of Divorce & Remarriage*, *53*, 453–463. <https://doi.org/10.1080/10502556.2012.682898>
- Heraclides, A., & Çakmak, G. A. (2019). *Greece and Turkey in conflict and cooperation: From europeanization to De-europeanization*. Routledge.
- Kenrick, D. T., Griskevicius, V., Neuberg, S. L., & Schaller, M. (2010). Renovating the pyramid of needs: Contemporary extensions built upon ancient foundations. *Perspectives on Psychological Science*, *5*(3), 292–314. <https://doi.org/10.1177/1745691610369469>
- Kim, P. S., Coxworth, J. E., J. E., & Hawkes, K. (2012). Increased longevity evolves from grandmothing. *Proceeding of the Royal Society B*, *279*, 4880–4884. <https://doi.org/10.1098/rspb.2012.1751>
- Lancaster, J. B., & Lancaster, C. S. (1987). The watershed: Change in parental investment and family-formation strategies in the course of human evolution. In J. B. Lancaster, J. Altmann, A. S. Rossi, & L. R. Sherrod (Eds.), *Parenting across the life span: Biosocial dimensions* (pp. 187–205). Aldine Publishing.
- Leary, M. R. (1999). Making sense of self-esteem. *Current Directions in Psychological Science*, *8*(1), 32–35. <https://doi.org/10.1111/1467-8721.00008>
- Nesse, R. M. (2019). *Good reasons for bad feelings: Insights from the frontier of evolutionary psychiatry*. Dutton.
- Rosenberg, M. (1965). Rosenberg Self-Esteem Scale (RSES) [Database record]. APA PsycTests. <https://doi.org/10.1037/t01038-000>
- Schmitt, D. P., & Buss, D. M. (1996). Strategic self-promotion and competition derogation: Sex and conflict effects on perceived effectiveness of mate attraction tactics. *Journal of Personality and Social Psychology*, *70*(6), 1185–1204. <https://doi.org/10.1037/0022-3514.70.6.1185>
- Schmitt, D. P., & Buss, D. M. (2001). Human mate poaching: Tactics and temptations for infiltrating existing mateships. *Journal of Personality and Social Psychology*, *80*(6), 894–917. <https://doi.org/10.1037/0022-3514.80.6.894>
- Schmitt, D. P., & Jonason, P. K. (2019). Self-esteem as an adaptive sociometer of mating success: Evaluating evidence of sex-specific psychological design across 10 world regions. *Personality and Individual Differences*, *143*, 13–20. <https://doi.org/10.1016/j.paid.2019.02.011>
- Shomaker, L. B., & Furman, W. (2010). A prospective investigation of interpersonal influences on the pursuit of muscularity in late adolescent boys and girls. *Journal of Health Psychology*, *15*(3), 391–404. <https://doi.org/10.1177/1359105309350514>
- Spielmann, S. S., MacDonald, G., Maxwell, J. A., Joel, S., Peragine, D., Muise, A., & Impett, E. A. (2013). Settling for less out of fear of being single. *Journal of Personality and Social Psychology*, *105*(6), 1049–1073. <https://doi.org/10.1037/a0034628>
- Thomas, A. G., Jonason, P. K., Blackburn, J., Kennair, L. E. O., Lowe, R., Malouff, J., & Li, N. P. (2020). Mate preference priorities in the East and West: A cross-cultural test of the mate preference priority model. *Journal of Personality*, *88*(3), 606–620. <https://doi.org/10.1111/jopy.12514>
- Tooby, J., & Cosmides, L. (2008). The evolutionary psychology of the emotions and their relationship to internal regulatory variables. In M. Lewis, J. M. Haviland-Johnes, & L. F. Barrett (Eds.), *Handbook of emotions* (3rd ed., pp. 114–137). Guilford.

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