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RESEARCH ARTICLE

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The mediating effect of the dark future between optimism-pessimism and fear of artificial intelligence in young adults from four Arab countries—a path analysis approach

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ABSTRACT

This study aimed to assess the mediating effect of the dark future between optimism-pessimism and fear of artificial intelligence (AI). This cross-sectional study was conducted between June and December 2023, enrolling 1849 participants from four Arab countries. The data were collected using a Google Forms. Path analysis was performed using SPSS AMOS v.30. The results revealed that the dark future mediated the associations between pessimism and fear of AI and between optimism and fear of AI. Higher pessimism was associated with more dark future, and more dark future with higher fear of AI. Higher optimism is linked to a less dark future, which is associated with elevated AI fear. Pessimism and optimism are indirectly associated with fear of AI. This study suggests that pessimism and optimism correlate with fear of AI through dark future views. This may aid future research aiming to highlight clinical implications for treating fear of AI and acceptance.

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KEYWORDS

Fear of artificial intelligence; optimism; pessimism; dark future; arab

Introduction

Artificial intelligence (AI) is defined as a simulation of human intelligence that is able to perform the cognitive functions and mental processes normally attributed to the human brain (Xu et al., 2021). Some define AI as an equivalent of human intelligence translated through machines undertaking tasks associated with human beings (Xu et al., 2021).

In recent years, AI has been offering transformative capabilities across various domains of patient care (Haug & Drazen, 2023). AI algorithms can rapidly and accurately process large datasets, helping healthcare professionals make timely and informed decisions (Obermeyer & Emanuel, 2016). Hence, these innovations underscore the growing role of AI in enhancing clinical decision-making and improving outcomes (Rabaan et al., 2022).

Despite its benefits, the rapid adoption of AI raises ethical concerns, particularly in sensitive areas such as education and healthcare (Enciso, 2025). Algorithmic bias is the main risk in the educational sector,

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where AI systems may harm existing inequalities in educational outcomes (Nguyen et al., 2023). Additionally, the lack of transparency in AI decisions complicates accountability, making it challenging to understand certain educational choices (Prakash et al., 2022). Addressing these ethical challenges necessitates the introduction of comprehensive guidelines and frameworks that prioritize fairness, transparency, and the protection of individual rights.

Fear of artificial intelligence

The growing influence of AI is accompanied by increasing apprehension about its potential to reshape societal norms and transform everyday life, which is commonly referred to as the 'fear of AI'. It encompasses a range of emotional and cognitive responses to the development and integration of AI technologies into our society (Kim et al., 2023). This phenomenon is referred to as 'AI anxiety' and includes concerns such as the potential loss of human control over intelligent systems. Li and Huang (2020) identify eight dimensions of AI anxiety that reflect both anticipatory fears about future disruptions and existential concerns about human autonomy amid advancing AI (Frenkenberg & Hochman, 2025).

Public opinion is deeply divided, ranging from optimistic views that celebrate AI as a getaway towards innovation, to pessimistic perspectives perceived as an existential threat (Shahvaroughi Farahani & Ghasemi, 2024). Given such divided perspectives, it is important to contextualize how AI is undeniably reshaping many facets of our future, including mental health (Beg et al., 2025). As observed by Beg et al. (2025), the use of AI in mental health offers many benefits, ranging from personalized sessions to psychotherapy support, and it has promising outcomes in tailoring interventions to individual needs. Nonetheless, they were able to show us through their study the significant limitations related to transparency, privacy, and ethical concerns; such matter highlights the importance of examining how people perceive and emotionally respond to AI and its new role in mental health. In fact, some of their recent studies have focused on the introduction of AI in psychologically sensitive situations such as psychotherapy. It showed to elicit a sense of fascination on the one hand and unease among a given population on the other hand (Beg & Verma, 2024). While working on AI-based psychotherapies for attention-deficit/hyperactivity disorder, obsessive–compulsive disorder, schizophrenia, and substance use disorders, Beg and Verma (Beg & Verma, 2024) were able to demonstrate how AI-based tools enhanced accessibility and clinical outcomes. For instance, obsessive-compulsive symptoms were reduced, and symptoms of depression and anxiety previously noted improved as well. On the other hand, it created fear and a sense of concern regarding the loss of empathy and diminished therapeutic alliance. The fear felt by most nowadays lies in the fact that AI is no longer a theoretical concept but rather an emerging reality. Against this backdrop, the present study aims to explore how individuals' general orientations—specifically, their levels of optimism and pessimism—are associated with their fear of AI (Hemade et al., 2024).

Association between optimism: pessimism and fear of AI

Personality traits (Hemade et al., 2024), including dispositions such as being optimistic or pessimistic (Kumar, 2023), may be involved in explaining the main causes of distress linked to rapidly evolving AI technology. These two outlooks significantly shape one's perception of the future (Qaisy & Thawabieh, 2016). Scheier and Carver (Scheier & Carver, 2018) define dispositional optimism as a stable personality trait with positive expectations about the future, contrasting with pessimism. Martin Seligman, through his work, suggested that optimism can be cultivated by changing one's perception of adversity (Peterson et al., 2009). Notably, earlier research (Alloy & Abramson, 1979) has shown that pessimists may possess a more realistic view of reality, whereas optimists often view the world through a biased lens (Carver et al., 2010). This interplay between accuracy and adaptability is crucial in understanding how these traits function in everyday life.

Therefore, it has become clear that optimistic individuals do not experience fear of change and novelties such as AI[13]. Global and cautious optimists, known for preparing for the worst, are those who have been associated with the highest level of life satisfaction. This may contribute to greater acceptance and a willingness to integrate AI into daily life (Glikson & Woolley, 2020). In contrast, pessimistic individuals may perceive AI as a threat (Golgeci et al., 2025). As AI becomes increasingly present in high-stakes domains, accounting for individual differences in dispositional outlooks becomes not just relevant but essential.

Dark future as a mediator in the association between optimism: pessimism and fear of AI

With this in mind, we now have a clearer understanding of how optimism and pessimism can significantly impact one's approach to daily challenges. Furthermore, the concept of a 'dark future' has also been introduced alongside these traits. It refers to a cognitive-affective orientation in which individuals anticipate a future marked by negative outcomes and existential threats (Patulny & McKenzie, 2022; Zaleski et al., 2019). The dark future encapsulates a more profound and often moralized sense of *dystopian inevitability* (Zeb et al., 2023). As such, it can be situationally activated and culturally shaped. This makes the dark future concept relevant in contexts involving emerging technologies (e.g. AI), where existential risk, loss of human control, or 'post-human' futures (Bostrom, 2014) are included.

Optimism has been found to alleviate dark future views, allowing buffering against anxiety and future uncertainties. Hence, positivity and open-mindedness correlate with ease of use and acceptance of AI, whereas lower levels of trust are associated with negative attitudes towards AI overall (Schepman & Rodway, 2023). Given that AI is perceived as a central component of the future, its acceptance becomes a litmus test for how individuals navigate technological change.

When these psychological elements are considered collectively, we understand how the dark future may statistically account for part of the association between dispositional traits—namely, optimism and pessimism—and the fear of AI. Zaleski proposed that the dark future was positively associated with negative present focus but was also strongly related to future anxiety (Zaleski et al., 2019). These associations suggest that individuals who experience heightened future-oriented anxiety potentially evaluate technological advancements through a more threatening lens. This theoretical framework logically extends to attitudes toward AI and the perceived burden it carries.

Through a study conducted among the Arab population, the results revealed how fear of a dark future was involved in mediating the association between negative emotions and an increasing fear of AI (Hemade et al., 2024). However, the study primarily examined the mediating effect of dark future thinking in relation to personality traits, as explored in the present research. This distinction is noteworthy, as optimism and pessimism are considered more malleable and shaped by numerous factors, whereas traits such as neuroticism and extraversion are generally stable over time. Thus, examining how dark future anxiety operates as a mediator between more fluid traits and the fear of AI deepens our understanding of how individuals psychologically process the rapid face of technological change. Figure 1)

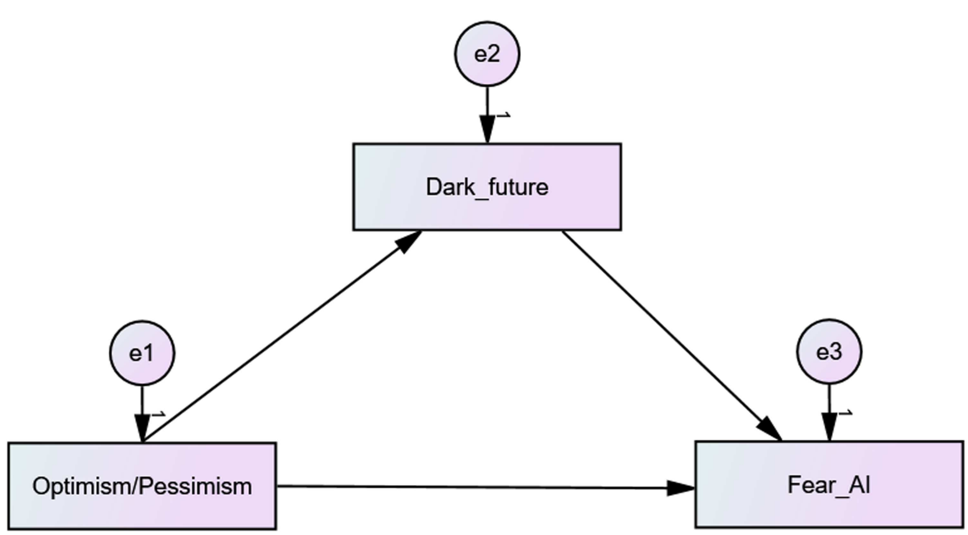

Figure 1. Theoretical framework of the indirect effect of dark future between optimism/pessimism and fear of artificial intelligence (AI).

The present study

The implementation of AI across the Arab world has encountered significant challenges, though efforts to overcome them are ongoing. Researchers have previously examined the factors influencing AI implementation in the UAE's healthcare sector (Alhashmi et al., 2020) and reported positive attitudes toward its integration (Alhashmi et al., 2020). In contrast, a similar study in Saudi Arabia (Abdullah & Fakieh, 2020) revealed more apprehension towards being replaced by AI. Here lies the importance of examining the different factors that shape perceptions of AI, particularly in a region marked by rapid development.

Individuals high in pessimism are therefore more likely to adopt a dark future worldview characterized by catastrophic expectations. Unlike general pessimism, dark future beliefs are context-specific and emotionally charged, with a focus on large-scale threats posed by emerging technologies (Bostrom, 2014). These beliefs act as a cognitive–affective filter through which AI is seen as a harbinger of irreversible harm. Consequently, dark future beliefs serve as the psychological mechanism by which a general negative outlook translates into specific anxieties about AI, mediating fear responses. Conversely, higher optimism may buffer individuals against developing such catastrophic visions, thus reducing fear of AI. Hence, it is crucial to understand how the aforementioned factors may affect one's views toward the future differently, providing a better understanding of how each individual deals with AI and anticipates uprising. Thus, our objective in this study is to assess the mediating effect of the dark future between optimism—pessimism—and fear of AI among young adults from different Arab countries. We therefore hypothesize that a stronger dark future would mediate the association between higher pessimism (vs. lower optimism) and higher fear of AI.

Methods

Procedure

This cross-sectional study was conducted between June and December 2023 and included 1849 participants. The data were collected using a Google form link. Snowball and convenient sampling techniques were used, which allowed the recruitment of respondents from different age groups, academic disciplines and social circles. The initial participants were asked to complete the questionnaire and then share the link within their networks, who, in turn, would pass it on through various social media platforms. The inclusion criteria for this study were as follows: being a resident and citizen of one of four Arab counties: Lebanon, Saudi Arabia, Morocco, and Palestine. Researchers from these four countries answered our call to participate and therefore were included. The only exclusion criterion was refusal to complete the questionnaire. First, the participants were asked to provide digital informed consent and then to complete the scales described below. The survey was anonymous, completed voluntarily and without remuneration.

Minimal sample size calculation

A minimal sample of 413 was deemed necessary using the formula suggested by MacKinnon (2007) to estimate the sample size: $n = \frac{L}{f2} + k + 1$, where f = 0.14 for small effect size, L = 7.85 for an α error of 5% and power $\beta = 80\%$, and k = 11 variables to be entered into the model.

Effect sizes are calculated based on R^2 values, with a value of 0.02 considered weak, 0.15 considered moderate, and a value of 0.35 considered high (Cohen, 2013).

Ethics approval and consent to participate

The Ethics and Research Committee of the School of Pharmacy at the Lebanese International University approved this study protocol (2023RC–022-LIUSOP). The participants provided freely-given, informed consent to participate in the study. Submitting the form online was considered equivalent to obtaining written informed consent. The study was performed in accordance with the Helsinki declaration and guidelines for research involving human subjects.

Data collection tools/measures

Anonymity and confidentiality were fully acknowledged. The questionnaire, designed in Arabic, comprised questions about sociodemographic characteristics such as age, sex, country of residence, living area, and calculating the Household Crowding Index (HCI), which is done by dividing the total count of people living in a household, excluding a newborn child, by the total number of rooms in that household, excluding the kitchen and bathrooms (Melki, 2004), in addition to answering the questions of the following scales:

Fear of Autonomous Robots and Artificial Intelligence (FARAI) (Liang & Lee, 2017). The FARAI scale, which is validated in Arabic (Fekih-Romdhane et al., 2023), is a psychometrically validated scale that was developed in order to assess the extent to which individuals are fearful of autonomous robots and AI. It comprises four statements (e.g. 'Robots that can make their own decisions and take their own actions'), which should be rated following a 4-point Likert scale based on how fearful they were about them: 1 (not afraid), 2 (slightly afraid), 3 (afraid), and 4 (very afraid). A higher score was indicative of greater fear of autonomous robots and A.

The Dark Future Scale (DFS), validated in Arabic (Karam et al., 2024), was developed to assess anxiety towards the future (Zaleski et al., 2019). It is a 5-item scale (e.g. 'I am afraid that the problems that trouble me now will continue for a long time') that is rated on a 7-point Likert scale from 0 (decidedly false) to 6 (decidedly true). Higher scores are linked to greater levels of future anxiety.

The Optimism–Pessimism Short Scale–2 (SOP2), validated in Lebanon (Moussa et al., 2023), is used to measure the psychological disposition of optimism with two items rated using a seven-point Likert scale from not at all optimistic (1) to very optimistic (7) for Item 1 and from not at all pessimistic (1) to very pessimistic (7) for item 2 (Nieß et al., 2022). In order to obtain an optimism scale score, the negatively worded item is recorded, and the unweighted mean score of the two items is computed (e.g. 'The next question deals with optimism. Optimists are people who look to the future with confidence and who mostly expect good things to happen. How would you describe yourself? How optimistic are you in general?'). Because each item represents a distinct construct, they were modeled as two separate observed variables rather than as indicators of a single latent factor. The current Cronbach's α is 0.66. Although the α value was lower than the usual recommended value of 0.70, the scale was retained for the analysis since it is an ultra-short measure designed to capture multiple facets of optimism/pessimism with only two items. Therefore, low internal consistency is expected because of the broad construct coverage with a limited number of items. Moreover, reliability estimates such as α values are sensitive to scale length and item heterogeneity, and values between 0.60 and 0.70 are considered acceptable for brief scales in psychological and behavioral research (Loewenthal & Lewis, 2021).

Statistical analysis

No missing data were found in the study. We did not have many outliers, so they were included in the analysis. SPSS software v.25 was used for the statistical analysis. The FARAI score was considered normally distributed since the skewness (=0.176) and kurtosis (=−0.475) values varied between −1 and +1 (Hair et al., 2021). Student's t test was used to compare two means, ANOVA was used to compare three or more means, and the Pearson test was used to correlate two continuous variables. Path analysis was performed to examine the mediating effect of the dark future between optimism/pessimism and fear of AI using SPSS AMOS v.30 (Figure 1). It was tested using a non-parametric bootstrapping procedure with 500 bootstrap samples and bias-corrected 95% confidence intervals. The fit indices used to evaluate the adequacy of the model were the root mean square error of approximation (RMSEA ≤ 0.08), the Goof of Fit Index (GFI), the comparative fit index (CFI; both > 0.90) and the standardized root mean square residual (SRMR; ≤0.05) Standardized direct, indirect and total effects were reported, and mediation was considered significant when the bootstrap 95% CI did not include zero. Covariates were selected using a purposeful, data-driven approach, retaining variables associated with the dependent variable at $p < 0.250$ in bivariate analyses, following the framework of Bursac et al. (2008). This strategy balances theoretical and empirical considerations while avoiding overadjustment and multicollinearity. Recent statistical evidence indicates that including theoretically plausible but statistically irrelevant covariates can bias estimates and reduce

Table 1. Sociodemographic and other characteristics of the sample ($N = 1849$).

Variable	N (%)
Country	
Lebanon	625 (34.0%)
Saudi Arabia	342 (18.6%)
Morocco	469 (25.5%)
Palestine	403 (21.9%)
Sex	
Male	473 (25.7%)
Female	1366 (74.3%)
Living area	
Urban	1324 (72.0%)
Rural	515 (28.0%)
	Mean ± SD
Age (years)	21.35 ± 3.83
Household crowding index (person/room)	1.39 ± .78

Table 2. Characteristics of the scales used.

Scale	Number of items	Cronbach's α	Mean	Standard deviation	Skewness	Kurtosis
Optimism	1	0.66*	4.94	1.57	−0.497	−0.324
Pessimism	1	0.66*	3.03	1.60	0.071	−0.841
Dark future	5	0.87	14.32	7.54	0.071	−0.841
Fear of artificial intelligence (FARAI)	4	0.77	5.13	2.98	0.176	−0.475

Table 3. Measurement Invariance of the dark future and fear of artificial intelligence scales across countries in the total sample.

Model	CFI	RMSEA	SRMR	Model Comparison	ΔCFI	ΔRMSEA	ΔSRMR
Model 1: Dark future scale							
Configural	0.996	0.025	0.013				
Metric	0.993	0.024	0.018	Configural vs metric	0.003	0.001	0.005
Scalar	0.985	0.031	0.019	Metric vs scalar	0.008	0.007	0.001
Model 2: Fear of artificial intelligence scale							
Configural	0.992	0.047	0.006				
Metric	0.993	0.023	0.010	Configural vs metric	0.001	0.024	0.004
Scalar	0.934	0.056	0.015	Metric vs scalar	0.059	0.033	0.005

CFI = Comparative fit index; RMSEA = root mean square error of approximation; SRMR = Standardized root mean square residual.

precision (Cinelli & Hazlett, 2020; Heinze et al., 2018; Greenland, 2021). To ensure robustness, a sensitivity analysis including theoretically relevant covariates (age, sex, country and living area) was conducted, but this model exhibited poorer fit indices, supporting the parsimony and stability of the final model. We considered the mediation analysis to be significant if the boot confidence interval did not pass zero. $P < 0.05$ was deemed statistically significant.

Results

A total of 1849 participants participated in this study, with a mean age of 21.37 ± 3.84 years and 74.3% females. Other descriptive statistics of the sample can be found in Table 1. The description of the scales can be found in Table 2.

Before making cross-country comparisons or interpreting differential mediation results across countries, establishing measurement invariance of the instruments is critical. Measurement invariance was established at all levels for the dark future scale and partially (configural and metric levels) for the FARAI scale (Table 3).

Bivariate analysis of factors associated with FARAI scores

The results of the bivariate analysis of factors associated with FARAI scores are summarized in Tables 4 and 5. Compared with other countries, the results revealed that living in Lebanon was significantly associated with

Table 4. Bivariate analysis of factors associated with FARAI scores.

Variable	Mean ± SD	t/F	df/df1,df2	P
Country		14.14	3, 1835	**<0.001**
Lebanon	5.63 ± 3.00			
Saudi Arabia	4.48 ± 3.02			
Morocco	5.28 ± 2.92			
Palestine	4.75 ± 2.84			
Sex		1837	−2.74	**0.006**
Male	4.81 ± 2.99			
Female	5.25 ± 2.97			
Living area		1837	−2.17	**0.030**
Urban	5.04 ± 3.02			
Rural	5.38 ± 2.85			

Numbers in bold indicate significant *p* values.

Table 5. Pearson correlation matrix.

	1	2	3	4	5	6
1. Fear of artificial intelligence	1					
2. Optimism	−0.04	1				
3. Pessimism	**0.07****	**−0.49*****	1			
4. Dark future	**0.20*****	**−0.17*****	**0.28*****	1		
5. Age	0.01	0.01	−0.01	**−0.11*****	1	
6. Household crowding index	−0.02	**0.09*****	**−0.09*****	**0.08****	**−0.18*****	1

*$p<0.05$; **$p<0.01$; ***$p<0.001$. The numbers in the table refer to the Pearson correlation coefficients. The numbers in bold indicate significant correlations.

Table 6. Mediation analysis of dark future between pessimism/optimism and fear of artificial intelligence using the path analysis in the total sample.

	Total effect			Direct effect			Indirect effect		
Independent variable	Beta	p	95% CI	Beta	p	95% CI	Beta	p	95% CI
Model 1: without covariates									
Pessimism[a]	0.07	**0.005**	0.03 to 0.12	0.02	0.437	−0.03 to 0.07	0.06	**0.003**	0.04 to 0.07
Optimism[b]	−0.04	0.062	−0.09 to 0.004	−0.01	0.692	−0.06 to 0.04	−0.03	**0.003**	−0.05 to −0.02
Model 2: with covariates									
Pessimism[c]	0.13	**0.008**	0.04 to 0.22	0.01	0.807	−0.04 to 0.05	0.11	**0.004**	0.08 to 0.14
Optimism[d]	−0.04	0.096	−0.09 to 0.01	0.001	0.914	−0.05 to 0.04	−0.04	**0.004**	−0.05 to −0.03

The numbers in the table indicate standardized regression coefficients. The numbers in bold indicate significant *p* values. a = R^2 value = 0.040. b = R^2 value = 0.040. c = R^2 value = 0.044. d = R^2 value = 0.044.

higher FARAI scores in females compared to males and that living in rural areas than in urban areas. Moreover, higher pessimism and a dark future were significantly associated with higher FARAI scores (Table 5).

Mediation analysis using path analysis

The results of the mediation analysis (Table 6) revealed that the dark future entirely accounted for the associations between pessimism and fear of AI and between optimism and fear of AI.

The fit indices of the model with pessimism as the independent variable were acceptable: GFI = 0.999; SRMR = 0.014; RMSEA = 0.018 [90% CI 0.001–0.046]; CFI = 0.994. The indirect effect of the dark future on the relationship between pessimism and fear of AI was significant (Standardized Beta = 0.05; $p = 0.003$; 95% CI 0.04–0.07). Higher pessimism was significantly associated with a darker future (Standardized Beta = 0.29; $p = 0.005$; 95% CI 0.24–0.33), whereas a darker future was significantly associated with higher fear of AI (Standardized Beta = 0.19; $p = 0.002$; 95% CI 0.14–0.24).

When conducting the same analysis using the path analysis, the fit indices of the model with optimism as the independent variable were acceptable: GFI = 0.999; SRMR = 0.012; RMSEA = 0.014 [90% CI 0.001; 0.044]; CFI = 0.994. The indirect effect of dark future between optimism and fear of AI was significant (Standardized Beta = −0.03; $p = 0.002$; 95% CI −0.05; −0.02).

Higher optimism was significantly associated with a less dark future (Standardized Beta = −0.22; $p = 0.003$; 95% CI −0.22; −0.13), and a darker future was associated with higher fear of AI (Standardized Beta = 0.19; $p = 0.001$; 95% CI 0.15; 0.25). Pessimism and optimism were not directly associated with fear of AI in either model.

Stratification analyses

The results of the path analysis revealed that the dark future statistically mediated the associations between pessimism and fear of AI in all countries and between optimism and fear of AI in Lebanon, Morocco and Palestine (but not Saudi Arabia) (Table 7).

Discussion

This study aimed to assess fear of AI in relation to optimism and pessimism, on a sample of Arab community adults, along with the mediating effect of the dark future. The results suggested that the dark future statistically mediated the positive relationship between pessimism and fear of AI, as well as the inverse relationship between optimism and fear of AI.

Personality and dark future

It was demonstrated in past studies that personality traits, especially pessimism, represent the basis of future anxiety (Zaleski et al., 2019). In our study, we assessed how higher pessimism and lower optimism were significantly associated with a darker future. Statistically, pessimism was found to explain the variance in dark future thinking but, to a lesser extent, the variance in fear of AI. (O'Connor & Cassidy, 2007). On the other hand, optimism is positively correlated with mental well-being (Conversano et al., 2010) and future perception.

Dark future and FARAI

As we have previously discussed, AI is ubiquitous and elicits a sense of concern as to whether it will escape mankind's control and replace individuals (Gherheş, 2018). Recent studies have examined the risks that may potentially be associated with the use of AI in mental health (Beg, 2025). Several challenges were emphasized, and the importance of its responsible integration was underscored. To preserve the effectiveness and ethical integrity of AI tools in mental health, some critical factors need to be monitored (i.e: algorithmic biases and a lack of transparency). Such elements triggered controversial views and debates

Table 7. Stratification analysis: Mediating effect of dark future between pessimism/optimism and fear of artificial intelligence using the path analysis by country.

	Total effect			Direct effect			Indirect effect		
Independent variable	Beta	p	95% CI	Beta	p	95% CI	Beta	p	95% CI
Model 1: Lebanon									
Pessimism[a]	0.06	0.148	−0.02 to 0.14	−0.02	0.699	−0.09 to 0.06	0.07	**0.003**	0.05 to 0.10
Optimism[b]	−0.01	0.749	−0.10 to 0.07	0.02	0.768	−0.07 to 0.08	−0.02	**0.014**	−0.05 to −0.01
Model 2: Saudi Arabia									
Pessimism[c]	0.15	**0.004**	0.05 to 0.26	0.10	0.065	−0.01 to 0.21	0.05	**0.003**	0.02 to 0.10
Optimism[d]	−0.06	0.328	−0.16 to 0.06	−0.05	0.359	−0.16 to 0.06	−0.01	0.252	−0.05 to 0.01
Model 3: Morocco									
Pessimism[e]	0.08	0.087	−0.01 to 0.18	0.04	0.297	−0.05 to 0.15	0.04	**0.016**	0.01 to 0.09
Optimism[f]	−0.03	0.480	−0.14 to 0.06	0.02	0.805	−0.09 to 0.10	−0.04	**0.002**	−0.08 to −0.02
Model 4: Palestine									
Pessimism[g]	0.01	0.896	−0.10 to 0.11	−0.05	0.375	−0.15 to 0.06	0.06	**0.005**	0.02 to 0.11
Optimism[h]	−0.09	0.071	−0.18 to 0.01	−0.04	0.483	−0.15 to 0.07	−0.05	**0.005**	−0.09 to −0.02

The numbers in the table indicate standardized regression coefficients. The numbers in bold indicate significant *p* values. a = R^2 value = 0.082. b = R^2 value = 0.083. c = R^2 value = 0.066. d = R^2 value = 0.061. e = R^2 value = 0.055. f = R^2 value = 0.053. g = R^2 value = 0.042. h = R^2 value = 0.041.

concerning the consequences that this emerging phenomenon may have, as well as apprehension towards social and ethical implications in the near future. In our study, we were able to demonstrate how a darker future was associated with a greater FARAI. Considering that the future is known as a major source of anxiety (Zaleski, 1996) and that AI is one of the major components of the future, the FARAI becomes inevitable. Henceforth, it becomes clear how individuals with elevated levels of future anxiety are more likely to struggle with accepting this technology.

Mediation analysis

Although not practically very strong, the findings in our study are statistically significant, with optimism having a smaller effect on dark future thinking and fear of AI. Additionally, we were able to see that the dark future was involved in the association between pessimism and the FARAI. In other words, pessimism was positively associated with an increasing dark future, while more dark future was also correlated to higher fear of AI scores, but pessimism itself had no direct relationship with the fear of AI. The values obtained in our study are significantly important and should be well understood in order to comprehend the role of optimism, pessimism, and dark future, relating to FARAI.

Consistent with this findings, anxiety and negative emotions have been inversely associated with acceptance of AI and positively associated with fear of AI in a study aiming to relate personality types with fear and acceptance of AI (Sindermann et al., 2022). In our study, the value of R^2 obtained is relatively low, as is the effect size; however, in psychological models, it is not uncommon and does not invalidate the mediating effect demonstrated since it is of great conceptual significance, especially with a large sample size contributing to the statistical significance. In fact, it reflects the complexity and multifactorial nature of the psychological constructs discussed. Thus, since multiple variables may play a role in the exploration of a theoretical model, additional variables are needed to obtain a clearer picture of the full variability of fear of AI. This finding indicates that the values obtained should be interpreted cautiously, also suggesting the need for further research aiming to improve explanatory power.

Path analysis

The results of the path analysis revealed that the dark future fully explained the associations between pessimism and fear of AI in all countries and between optimism and fear of AI in Lebanon, Morocco and Palestine (but not Saudi Arabia). This finding can be explained by the vastly different socio-political and economic contexts of these countries. Lebanon and Palestine have experienced prolonged periods of conflict, political instability, economic hardship, and uncertainty (Jaspal et al., 2020; Assaf et al., 2025). Hence, the future is often viewed through a lens of unpredictability and threat. As a result, individuals who maintain optimism may counterbalance fear of AI and uncertainty by resisting narratives of doom and embracing hope for progress and positive change (Fasiku, 2024). In contrast, Saudi Arabia is relatively more stable and wealthier and has made significant investments in futuristic visions such as Vision 2030, including the integration of AI (Moshashai et al., 2020). Because basic needs and national stability are more secure, optimism in Saudi Arabia may not stem from resistance to chaos or hardship and thus may not be as tightly linked to fears of AI (Thamer, 2020). In this context, attitudes toward AI appear to be shaped more by state-driven narratives, technological trust, or economic considerations than by existential fears or personal beliefs (Taika, 2022).

Looking at the studies referenced above, we can say that individuals with a propensity toward a pessimistic approach to novelty are more likely to be uncomfortable with the rise of AI, as its growth requires adaptation.

Clinical implications

As we have seen, the increasing involvement of AI in various fields has sparked both excitement and concern. Hence, the results obtained are crucial at different levels.

First, while the association between pessimism and fear of AI may appear intuitive, it still has significant implications. This finding underscores the role of stable personality traits in shaping individuals' response to technological change. Since pessimism is linked to the expectation of negative outcomes, it may serve as a psychological barrier to adaptability and resilience in future-oriented environments. Incorporating validated personality assessments into selection or support processes could enable more targeted interventions.

Second, understanding the mediating effect of the dark future guide therapeutic interventions and allow the development of techniques that reduce AI-related fear and anxiety. Additionally, such apprehension towards AI awakens existential concerns; therefore, therapists can help develop resilience and optimistic thinking. Therapy techniques such as cognitive–behavioral therapy can be used in favor of addressing such issues.

Third, such results establish a framework for subsequent studies aiming to explore how perceptions of AI evolve through time. This will allow interventions for the management of AI-related fear and anxiety at different stages of its implementation. Thus, further research will help address and explore the effectiveness and gaps of various methods concerning AI education.

Finally, future research on the relationships among optimism, pessimism, the dark future, and fear of AI can benefit from broader cultural comparisons, longitudinal designs, and the inclusion of additional psychological constructs. Expanding beyond Arab countries to include diverse cultural contexts can help determine whether these relationships are universal or culturally specific. Incorporating variables such as technological literacy, resilience, and coping styles may offer deeper insight into how individuals process such change. Longitudinal studies could reveal how these perceptions evolve as AI becomes more integrated into daily life.

Limitations

Our study presents some limitations. This is a cross-sectional study and therefore captures only a snapshot of data at a specific point in time. This limits the ability to establish causal relationships or determine the direction of the associations between our variables. Additionally, females outnumbered males, with a disproportionate ratio between them and participants, who were recruited from four Arab countries. Importantly, the gender imbalance within our recruited population could have also affected the studied psychological constructs, given the different ways emotions and thoughts may be processed in each gender. Furthermore, the sample consisted of mainly young adults, most likely suggesting a largely student convenience sample. Participants were recruited through an online survey distributed via social media using a snowball sampling technique, which is considered a key limitation, as it introduces potential selection bias. Response rates could not be precisely determined since Google Forms do not allow us to do so. Thus, the sample we obtained does not fully reflect the general population, given that external validity and generalizability are limited. In addition, the R^2 values of the models (total sample and by country) are low; consequently, the findings should be interpreted cautiously. Future studies should take this into account and aim to recruit more balanced and diverse samples with respect to demographics and gender. In addition, we measured optimism and pessimism using a scale consisting of few items, which is important because it may have lower reliability or underestimate the observed associations. Nonetheless, the scale used was validated and still supports the overall reliability of our findings. Moreover, we based our results on self-reported measures to assess our variables, which implies that information bias is probable, as well as recall bias and inaccuracies. Such factors can potentially affect the validity and reliability of the data. To improve the validity of future studies, objective measures should be used, as well as implementing multi-method approaches for more accurate data. Because optimism and pessimism are each assessed by a single item, these constructs were modeled as observed variables, precluding latent measurement or invariance testing across countries. Accordingly, cross-national differences should be interpreted cautiously. Notably, many other important variables may have a relevant role and are worth considering in upcoming studies since they interact together and may contribute to different outcomes of studies, which limits the reliability of our findings. This can be addressed by taking multiple variables into consideration for more comprehensive insights as well as identifying causality rather than just correlation. In addition, longitudinal studies should be prioritized. This powerful design allows for the collection of data over longer durations, which implies long-term effects and outcomes. Additionally, it helps develop a cause–and–effect relationship, providing more solid evidence.

Conclusion

This study contributes to understanding how pessimism and optimism may be related to fear of AI through the perception of a dark future among 1849 young adults from the Arab region. These results underscore the importance of addressing negative future perceptions when individuals are seeking to reduce AI-related fears, particularly in individuals with pessimistic tendencies. By integrating psychological insights into the implementation of AI, stakeholders can develop strategies that foster trust and reduce resistance. Mental health practitioners and educators could design interventions that challenge cognitive distortions about the future and promote future-oriented optimism. Moreover, policymakers might consider incorporating psychological profiling into AI awareness campaigns to tailor messaging more effectively to better address societal and ethical concerns. Future research should explore additional psychological or contextual mediators, such as resilience, trust in institutions or media exposure, that could either mitigate or intensify the fear of AI. Longitudinal and cross-cultural studies would be valuable in understanding how these dynamics evolve over time and across different populations.

Author contributions

SH, FFR and SO are involved in the study design. GAK wrote the manuscript; DM, NM, TR, RA, KJ, BZ, FS, MD, AA, and HAMS were responsible for the data collection. SH was involved in the data analysis and interpretation. RH revised the paper for intellectual content. All the authors approved its final version.

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Data availability statement

All the data generated or analyzed during this study are not publicly available. The dataset supporting the conclusions is available upon request to the corresponding author (SH).

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