

Factors Influencing Researchers to Publish in Open-Access: Is it a Self-Decision or a Self-Reinforcing Cycle?

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Abstract

Purpose

The current study examined Israeli researchers from various disciplines concerning their perceptions, attitudes, and awareness of scientific publications in OA journals and repositories.

Design/methodology/approach

A survey instrument was developed and distributed to 202 Israeli researchers from universities, colleges, and research institutions. The study used the united theory of acceptance and use of technology (UTAUT) model as a tool for mapping the factors known to influence researchers to publish in OA journals and repositories.

Findings

The empirical model confirmed the mediating effect of the association between researchers' perceptions and the actual publishing in OA, through their behavioral intentions (BI). Furthermore, the BI are mediated by researchers' self-decision to publish in OA. More specifically, a researcher's publication level in OA depended not only on the positive attitudes, performance expectancy, and social influence mediated by BI, but also on conditions that support researchers who publish in OA, and disciplinary affiliation to STEM which lead the researcher to voluntarily publish in both green and gold OA.

Research limitations/implications

This study contributed to the cumulative understanding of OA publishing by formulating and validating an empirical research model of acceptance and use.

Practical implications

The implications of the findings for scientific publication theory and practices are discussed.

Originality/value

The study suggests an effective framework to understand the researcher's final decision to publish in OA. This study's results are an essential step towards the cumulative understanding of OA publicity adoption and use by researchers as a global issue in general and in Israeli academic institutions in particular.

Keywords: Open-Access (OA) publication, researchers' perceptions, behavioral intentions to publish OA, voluntariness of publication, actual publications in OA

Introduction

Traditional scientific publishing faces new opportunities and challenges in the digital age. Scientific journals are distributed and retrieved in an online format, which costs significantly less than printing journals (Björk, 2017). However, online toll-access journals restrict access to full articles and create a trend to commercialize scientific knowledge (Wallach *et al.*, 2018). Advocates of open access to scientific publishing argue that the traditional model, in which research findings remain behind paywalls for the public, is not sustainable (Harnad, 1995; Suber, 2003). These allegations have created an active public debate that established the “open access” (OA) movement.

OA publishing benefits the public, and provides potential benefits for individual authors. Previous studies have found that there are accelerating and inhibiting factors for OA publishing, while the most discussed potential advantage is associated with OA articles' citation impact as a result of increased visibility and accessibility (Piwowar *et al.*, 2018). However, along with its benefits, OA faces challenges and limitations that prevent its full development (Shen and Björk, 2015). One of the significant limitations is the journal “impact factor” (IF), which directly affects researchers' promotion and tenure (Blankstein and Wolff-Eisenberg, 2019). Since the OA publishing model was not established until recently, OA journals normally have a lower IF, especially in the social sciences and humanities disciplines (Pollock and Michael, 2019). Another limitation is the “predatory” journals, which are those that prioritize self-interest at the expense of scholarship and are characterized by false or misleading information (Beall, 2015).

In addition, the transition to an author-paid model requires a publication fee known as an “article processing charge”, or APC (Halevi and Walsh, 2021; Tennant *et al.*, 2019). Therefore, researchers and faculties who lack funds, representatives of the social sciences, humanities, and emerging disciplines may find themselves at a disadvantage (Bosman and Kramer, 2018). OA journals (gold OA) and repositories (green OA) are well developed in STEM disciplines (Science, Technology, Engineering, Math) compared to their counterparts in the humanities and social sciences (Momeni *et al.*, 2021).

In addition to the disciplinary differences, there are large disparities between countries in OA adoption (Martín-Martín *et al.*, 2018). Unfortunately, there is limited awareness of OA publishing in Israel and there is no policy or legislation regarding OA publishing issues (Moskovkin *et al.*, 2021). The aim of this study was to formulate and validate a comprehensive research model regarding the acceptance and usage of OA in Israel, and to determine the factors that lead Israeli researchers to publish in OA journals and repositories. Thus, the current study examined Israeli researchers' perceptions, attitudes, and awareness from various research disciplines concerning scientific publications in OA journals and repositories, in order to determine which of these factors influence researchers' behavioral intentions. Further, the study also explored how these behavioral intentions predicted publication in OA in practice.

Literature Review

A Brief Review and Analysis of the Current Situation

In order to understand the current situation from the researchers' viewpoint, it is necessary to look at how the OA movement evolved. The movement began in the 1990s, as access to the Internet became widely available and online publishing became the norm (Gasparyan *et al.*, 2019; Laakso *et al.*, 2011). One of the seminal texts of OA was *A Subversive Proposal* by Harnad (1995), which called on researchers to make freely available papers they published in scholarly journals freely available on the Internet. Between 2001 and 2003, a series of institutional statements were made: *The Budapest OA Initiative* and *The Bethesda Statement on OA Publishing* in 2002, and *The Berlin Declaration on OA in 2003*. These initiatives, known as the BBB declarations, sketched out the ideological basis of the movement (Gasparyan, 2019). Velterop (2003) suggested three criteria for OA: free accessibility, further distribution, and proper archiving. According to Suber (2015, para. 1), an OA work is digital, online, free of charge, and free of most copyright and licensing restrictions.

Following these initiatives, major research institutions across the globe committed themselves to provide OA for their research output (Sanjeeva and Powdwal, 2017). More recently, grant requirements for over 100 funding organizations, including Plan S and Europe PMC Funders' Group, and Open Research Europe platform increasingly require peer-reviewed research output to be freely available. These aims can be achieved either by publishing in OA journals (known as the "gold OA"), or by archiving publications in an OA repository ("green OA"), or in some cases both are required. Thus, more recent definitions of OA define OA articles as "free to read online, either on the publisher's website or in an OA repository" (Piwowar *et al.*, 2018. p.4).

OA's Effect on Researchers and the Israeli Context

According to *SCImago Journal and Country Rank*, which includes scientific indicators based on Scopus database (www.scimagojr.com/countryrank.php), the rate of Israeli OA publications (32.32%) is lower than European countries. Such those closest to Israel in general scientific publications quantity are Austria (46.43%) or Finland (44.56%), and even the world average (33.85%). In addition, according to Moskovkin *et al.*'s (2021) index of countries involved in the OA movement, Israel is ranked 96th, compared to Finland (27th) and Austria (28th). For researchers, OA can increase their audience and impact by delivering wider and easier access for readers (Björk, 2017; Zhu, 2017). Nevertheless, OA scientific publications includes subcategories and varying interpretations, which are the basis for the existing debate between those researchers who support or oppose OA, notably among humanities scholars (Beall, 2015; Natale, 2019; Wallach *et al.*, 2018).

Theoretical Framework, Research Model, and Hypotheses

Several frameworks explain the lack of acceptance as being due to personal reasons, technology characteristics, or user experience (e.g., Davis, 1989; Author1 *et al.*, 2020; Rogers, 1995). Venkatesh *et al.* (2003) synthesized eight representative research models and prominent theories in order to predict or explain new technology/information system adoption, acceptance, and usage, calling it the unified theory of acceptance and use of technology (UTAUT) model. However, the UTAUT model has rarely been applied in OA related studies (e.g., Garone *et al.*, 2019; Kocaleva *et al.*, 2015; Lwoga and Questier, 2014). The UTAUT model includes seven structures: four were included in the final model (performance expectancy, effort-expectancy, social-influence, and facilitating conditions). Regarding the other three (attitude, self-efficacy, and anxiety), although the final UTAUT model does not include them as direct determinants, it would be valuable to re-examine their influence in the context of OA publications. Based on the UTAUT model, the current study established the relationships between the factors influencing OA (see Figure 1) and set the hypotheses tested in this research, as detailed below:

1. Performance-expectancy (PE) is the degree to which an individual believes that using the system will help attain gains in job evaluation (Venkatesh *et al.*, 2003). Many OA journals advertise a rapid publication process compared to increasing delays in the traditional publication timeline—a significant benefit for researchers at the start of their careers (Shamseer *et al.*, 2017; Woszczyński and Whitman, 2016). Nevertheless, promotion and tenure processes significantly influence where researchers publish their articles (Olejniczak and Wilson, 2020). In most academic disciplines, it is considered necessary to have publications in journals with high journal IFs (the yearly average number of citations) in order to succeed, especially for those on the tenure track (Schmidt *et al.*, 2018). Thus, as found in previous studies, due to promotion considerations, younger, junior, and female academics had less experience with OA journals which, in many cases, had a less established IF (Olejniczak and Wilson, 2020; Zhu, 2017). Although some studies have reported higher citation counts for OA, suggesting an “open access citation advantage” (OACA), its magnitude varies substantially depending on the discipline, mostly in STEM areas (Pollock and Michael, 2019). These rationales lead to the following hypotheses:

H1_a: PE significantly affects researchers’ behavioral-intentions to publish OA.

H2_a: PE significantly affects researchers’ actual OA publication level.

H3_{a-c}: Significant differences will be found. The higher the rank, seniority and tenure status, the higher the level of OA publication.

H3_a: Significant differences will be found for gender. Male researchers will publish more OA articles than will female researchers.

2. Effort-expectancy (EE) is the degree of ease associated with using the system (Venkatesh *et al.*, 2003). Davis (1989) found that the easier and simpler the information system is perceived

to be, the more likely it is that this system will be accepted and adopted by users. Studies have found that expectation of effort increases anxiety about failure, and therefore the user avoids using the system (Garone *et al.*, 2019). With respect to OA, lack of knowledge about OA publication causes an expectation of effort, which adversely affects researchers' willingness to publish in OA journals and repositories (Lwoga and Questier, 2014; Ten-Holter, 2020). These rationales lead to the following hypotheses:

H1_b: EE significantly affects researchers' behavioral-intentions to publish OA.

H2_b: EE significantly affects researchers' actual OA publication level.

3. Social-influence (SI) is the degree to which an individual perceives that important others believe s/he should use the new system (Venkatesh *et al.*, 2003). The role of SI in technology acceptance decisions is complex and subject to a wide range of contingent influences, and has an impact on individual's behavior, especially in the early stages of experimenting with a system (Venkatesh and Davis, 2000). The social impact of researcher's environment was presented in many studies as predicting researcher's behavioral intentions and actual publishing in OA (Kocaleva *et al.*, 2015; Lwoga and Questier, 2014). Therefore, the following hypotheses were proposed:

H1_c: SI significantly affects researchers' behavioral-intentions to publish OA.

H2_c: Social-influence significantly affects researchers' actual OA publication level.

4. Facilitating conditions (FC) are the degree to which an individual believes that an organizational and technical infrastructure exist to support the use of the system (Venkatesh *et al.*, 2003). Publishing in an OA journal requires funding, known as the article-processing charge (APC) and is listed among the barriers preventing authors from publishing articles in the OA model (Halevi and Walsh, 2021; Tennant *et al.*, 2019). While, STEM researchers have access to resources enabling them to afford APCs, other researchers struggle to procure funds to publish in OA (Olejniczak and Wilson, 2020). This might affect those working in fields such as the social sciences and humanities, or early-career researchers, for whom research grants and publishing fees are more difficult to obtain (Natale, 2019; Zhu, 2017). Therefore, the following hypotheses were proposed:

H1_a: FC significantly affects researchers' behavioral-intentions to publish OA.

H2_a: FC significantly affects researchers' actual OA publication level.

H3_e: Significant differences will be found among disciplines. STEM researchers will publish more OA articles than will social science and humanities researchers.

5. Attitude (Atti) toward using technology is an individual's overall affective reaction to using a system (Venkatesh *et al.*, 2003). Several studies have found that authors rated OA publishing as low-prestige, and consider that fully OA journals lack rigor (Woszczynski and Whitman, 2016). There is a widespread perception that articles in OA journals were chosen because they make money rather than because they represent quality research (Natale, 2019).

In contrast, Pollock and Michael (2019) found no evidence suggesting that OA journals suffer significant quality issues compared with non-OA journals. These rationales lead to the following hypotheses:

H1_e: Attitude significantly affects researchers' behavioral-intentions to publish OA.

H2_e: Attitude significantly affects researchers' actual OA publication level.

6. Self-efficacy (SE) refers to one's belief in their capacity to execute behaviors necessary to produce specific performance, and reflects confidence in the ability to exert control over one's behavior and social environment (Bandura, 1994). According to the internal-external efficacy model, the definition of SE must include influencing external resources (Simmons *et al.*, 2014). Yaakobi (2018) refers to SE in terms of inner beliefs of the individual that address a person's ability to interact with others, as well as others' willingness to provide sufficient resources to accomplish the task. Regarding OA publication, such sufficient resources can be national or institutional OA policy, or a self-deposit repository (Moskovkin *et al.*, 2021; Ten-Holter, 2020). These rationales lead to the following hypotheses:

H1_f: SE significantly affects researchers' behavioral-intentions to publish OA.

H2_f: Self-efficacy significantly affects researchers' actual OA publication level.

7. Anxiety (ANX) towards using technology is being anxious or having emotional reactions when it comes to performing a behavior (e.g., using information systems) (Venkatesh *et al.*, 2003). Researchers have some concerns about OA publishing, such as copyright, quality of OA journals and inability to pay APCs (Shamseer *et al.*, 2017; Zhu, 2017). Further, predatory journals that publish manuscripts with little or no peer review for payment, are considered one of the main reasons for authors' anxiety regarding OA (Laakso *et al.*, 2021; Tennant *et al.*, 2019). The amount of spam such publishers send to academics has likely tainted the reputation of serious OA publishers (Björk, 2017). These rationales lead to the following hypotheses:

H1_g: Anxiety significantly affects researchers' behavioral intentions to publish OA.

H2_g: Anxiety significantly affects researchers' actual OA publication level.

In order to enhance the model's ability to predict the acceptance of OA publications, the current study included personal factors with some adaptations to the current environment of academic publication, as detailed below.

8. Voluntariness of Publicity (VoP) – voluntariness of use according to UTAUT is defined as “the degree to which use of the innovation is perceived as being voluntary, or of free will” (Moore and Benbasat, 1991, p. 195). OA shifts the financing of scholarly publishing, and authors become the customers in scholarly communication (Beall, 2015). Indeed, some researchers reported that without the funding and requirement of funders to publish in OA journals and repositories, they probably would not have done so (Brainard, 2021). As the ability to examine voluntary use versus mandatory use is essential in order to measure the intent to

use the system being implemented (Venkatesh *et al.*, 2012), the following hypotheses are proposed:

H4_a: VoP significantly affects researchers' behavioral-intentions to publish OA.

H4_b: VoP significantly affects researchers' actual OA publication level.

9. Awareness of OA (AWA) is, according to Schmidt *et al.* (2018), taking OA to the next level. This first requires researchers to be aware of the importance of openness, followed by skills development such as adopting new research practices. As lack of awareness of the key concepts in OA publishing had a negative effect on researchers' support for (Barrett *et al.*, 2017; Morais and Borrell-Damián, 2018), the following hypotheses were proposed:

H5_a: Awareness significantly affects researchers' behavioral-intentions to publish OA.

H5_b: Awareness significantly affects researchers' actual OA publication level.

10. Cognitive flexibility to changes (CF) can be considered as person's ability to face change and is highly valued at the individual level in this modern world of work, and in society (Di Fabio and Gori, 2016). Understanding and accepting changes are crucial for personal development (Wanberg and Banas, 2000). Changing the traditional subscription model requires researchers to make an extra effort and be willing to accept changes (Schmidt *et al.*, 2018). As CF addresses people's ability to change decisions and routines easily (Di Fabio and Gori, 2016), the following hypotheses were proposed:

H6_a: CF to changes significantly affects researchers' behavioral-intentions to publish OA.

H6_b: CF to changes significantly affects researchers' actual OA publication level.

According to Venkatesh *et al.* (2003), **behavioral intention (BI)**, the willingness of respondents to use the system, plays a vital mediating role in actual use. A meta-analysis by Khechine *et al.* (2016) confirmed that BI was significantly and positively influenced by the core UTAUT factors, and positively predicted actual use. Thus,

H7: BI significantly affects researchers' actual OA publication level.

H8_{a-j}: BI significantly mediates the relationship between researchers' perceptions (H8_{a-g}), VoP (H8_h), AWA (H8_i), CF (H8_j) and the actual level of OA publication.

Research Aims and Model

The current study examined Israeli researchers from various disciplines concerning their perceptions, attitudes, and awareness of scientific publications in OA journals and repositories. In this study, the UTAUT model was chosen as a basis for investigating researchers' perceptions of OA, in order to determine which of these factors influence the researcher's behavioral intentions and how these intentions predict the publication in OA in practice. Figure 1 presents the conceptual research model. The relationships among the constructs (arrows) represent the research hypotheses.

Figure 1
Research model

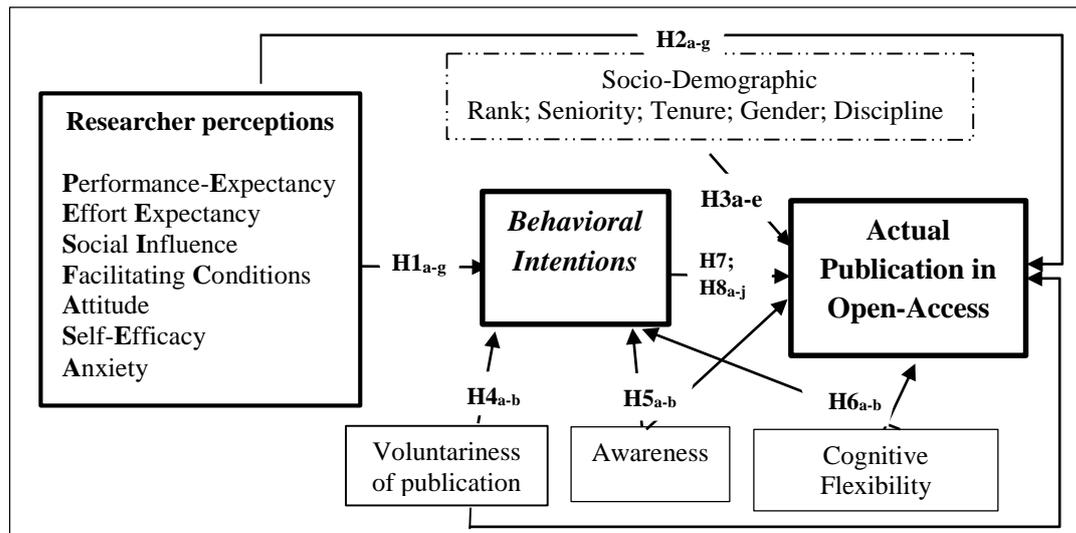


Figure legend:

- In bold: Main UTAUT variables (PE, EE, SI, FC, including Attitude, SE and Anxiety as independent variables; BI and APiOA as dependent variables).
- In bold and italic: Mediator UTAUT variable.
- Dashed/outlined: Socio-demographic characteristics variables based on UTAUT and adapted to the present study. Additional variables correspond to the research context.
- Awareness of OA and Cognitive flexibility to changes –additional variables.

Method

Participants

The research employs a quantitative research design in which a questionnaire is distributed through researchers' email list on the faculties website or/and through the faculty secretariat. The final number of emails sent was 2,508 (approximately half of the senior academic staff in Israel) and an email with a link to the web-based questionnaire was sent out in May and August of 2020. In total, 202 valid responses were received, a response rate of 8%. The demographic information is presented in Table 1.

Table 1
Socio-demographic characteristics (N=202)

Variable	Values	Code	N	(%)
Discipline	Social Sciences and Humanities	1	106	52.5%
	Exact Sciences - STEM	2	96	47.5%
Gender	Female	1	77	38.1%
	Male	2	125	61.9%
Academic rank	Assistant lecture	1	18	9%
	Lecturer	2	30	14.9%
	Senior Lecturer	3	73	36.1%
	Associate Professor	4	44	21.8%
	Professor	5	37	18.3%
Tenure	Not a candidate for tenure	1	23	11.4%
	Candidate for tenure	2	56	27.7%
	Tenure	3	123	60.9%
Seniority	3 years and below	1	6	3%
	4-6 years	2	15	7.4%
	7-10 years	3	41	22.8%
	11-15 years	4	98	20.8%
	16 years and above	5	52	46%

Instruments and Procedures

The structured questionnaire contained closed questions in separate sections, pre-tested with a pilot group of 30 academic researchers, assessed by determining the reliability and validity, and refined and corrected according to the data that emerged from the pilot study. Convergent validity was verified by Fornell and Larcker's (1981) criterion which requires the average variance extracted (AVE) to be greater than 0.5 and Hair et al.'s (2010) criterion requiring an addition standardized factor loading of all items to be not lower than 0.5, and a composite reliability not lower than 0.7. These analyses were re-performed in the final sample of the 202 questionnaires. The procedure and the variables are listed below:

- A. **Personal and socio-demographic characteristics**—Gender, seniority (experience according to UTAUT), and relevant academic information such as tenure status, discipline, and academic rank (see Table 1).
- B. **Voluntariness of publicity (VoP)**—Researchers were asked who made the decision to publish in an open journal or repository. They were presented with a scale having 6 options: two of them indicated an independent and voluntary choice to publish in OA: a) the decision to publish my work in the OA was mine; b) a joint decision with my research partners. The following three options indicated publication in OA not by self-choice; c) I published in an open journal/repository due to research founder's requirement; d) the decision was made by the research partners only; e) decision of the employer institution. The last option was:

f) I did not publish in an open journal/repository. The six options were coded on a three-level ascending order scale:

1 = Did not publish at all in OA journals/repository (53 researchers, 26.2%);

2 = Published in OA journals/repository not voluntary (30 researchers, 14.8%), and

3 = Published in OA journals/ repository by self-choice (119 researchers, 58.9%).

C. **Awareness(AWA) Index** included six statements referring to basic and key concepts in OA publication based on questionnaires and studies regarding OA publication (Barrett *et al.*, 2017; Morais and Borrell-Damián, 2018). Researchers were asked to rate their answer for each concept (green, gold, and hybrid OA; Creative Commons license, predatory journal), on a five-point Likert scale from “not familiar at all” to “very much familiar with”. In both tests, the pilot group and the research itself, and all factor loadings were $>.61$, AVE $>.61$. Consequently, all items were included in the indices. Cronbach’s alpha measures were $>.84$, composite reliability $>.89$, indicating good reliability of the indices. Concerning descriptive statistics, $M=2.24$, $SD= 1.05$, Skewness = $.875$.

D. **Cognitive-flexibility (CF) to changes index** included four items adopted from the “CF” scale from the *Acceptance of Change Scale (ACS)* questionnaire (Di Fabio and Gori, 2016). Reliability in the original study for the four items scale was $\alpha = 0.72$. The items were measured on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). In both tests, for the pilot group and research itself, all factor loadings were $>.61$, AVE $>.51$. Consequently, all items were included in the indices. Cronbach’s alpha measures were $>.84$, composite reliability. Above $.80$ indicates good reliability of the indices. The descriptive statistics were: $M=2.24$, $SD= 1.05$, Skewness = $.875$.

E. **Acceptance and adoption of open-access publication**. The measurement factors and items were adapted from the UTAUT model of Venkatesh *et al.* (2003). The questionnaire included seven scales/factors as independent variables: PE, EE, SI, FC, Atti, SE and ANX. In order to make them relevant in the current context, the items were modified based on two questionnaires: the *OA Publishing Survey* (Barrett *et al.*, 2017) and *Publish in OA Journals Questionnaire* (Woszczyński and Whitman, 2016) and were measured on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The questionnaire items refer to both: OA journals (gold OA) and repositories (green OA). Descriptive statistics, reliability, and factor loadings for acceptance and adoption of OA publication questionnaire are presented in Table 2.

Table 2

Descriptive statistics, reliability and factor loadings for Acceptance and Adoption of Open Access Publication Questionnaire (N=202)

Factors		Factor loading	M	SD	Skewness (SD)	Cronbach's alpha	CR	AVE
1) Performance Expectancy (PE)	(4 items)	.794-.891	3.02	1.17	-.073 (.17)	$\alpha=.88$	.91	.73
2) Effort Expectancy (EE)	(5 items)	.634-.754	3.09	.95	-.042 (.17)	$\alpha=.75$	.83	.50
3) Social Influence (SI)	(5 items)	.520-.874	2.15	.84	-.488 (.17)	$\alpha=.78$	.85	.55
4) Facilitating Conditions (FC)	(3 items)	.843-.889	3.31	1.17	-.344 (.17)	$\alpha=.84$	.90	.75
5) Attitude (Atti)	(3 items)	.761-.810	2.93	1.06	-.129 (.17)	$\alpha=.68$	.82	.60
6) Self-Efficacy (SE)	(4 items)	.737-.906	3.34	1.16	-.497 (.17)	$\alpha=.86$	.91	.71
7) Anxiety (ANX)	(3 items)	.712-.799	3.69	.989	-.202 (.17)	$\alpha=.67$	.80	.58

As shown in Table 2, convergent validity was verified and achieved; therefore, results offer strong confirmation of convergent validity.

F. The dependent variables were behavioral intention, which is also considered a mediator variable, and actual publishing in OA ("Use Behavior" according to UTAUT).

Behavioral Intentions (BI) were measured by asking the researcher/respondent, "Do you intend to publish in OA journals and/or repositories in the coming year?". Answers were coded on a three-level ascending order scale: 1=Do not intend to publish (62 researchers, 30.69%); 2=May publish (101 researchers, 50%); 3= Yes, intend to publish in the open approach in the near future (39 researchers, 19.31%).

Actual Publication Level in Open Access (APiOA) was measured by asking the researcher, "How many articles have you published in OA journals and/or open repositories?" Answers were coded on a five-level ascending order scale: 1) I did not publish in OA at all (53 researchers, 26.2%); I have published/deposited: 2) 5-10 OA articles (88 researchers, 43.6%); 3) 6-10 OA articles (20 researchers, 9.9%); 4) 11-20 OA articles (20 researchers, 9.9%); 5) 21 OA articles and above (21 researchers, 10.4%).

Results

In order to examine the research assumptions (see Figure 1), as a preliminary support, Pearson's correlation coefficient and Spearman's rank-order correlation matrix were conducted to examine the relationship between research model variables and their association with behavioral intention and actual level of OA publication. According to the results, performance and effort expectancy, social influence, facilitating conditions attitude and voluntariness of publication were lower to moderately and significant positively correlated with researchers' *Behavioral Intentions* and *actual publication in OA* (.138*-564***). As anticipated, anxiety was negatively associated with BI (-.238**) and APiOA (-.168*). On the other hand, self-efficacy and awareness to OA have no significant relationship with either BI or APiOA. The

only significant correlation of these variables was found with PE (SE=.480***, awareness=.143*), a finding that may indicate an indirect correlation with researcher's BI and APiOA. The next analysis examined the direct effect of research model variables (independent variables) on APiOA (dependent variable), and the indirect effects when mediated by BI (mediation variable). This examination was conducted according to Baron and Kenny's (1986) mediation analysis, known as the four-step model, which proposed a sequential verification under four conditions, as illustrated in Table 3 and explained below.

Table 3

Mediation analysis regression results: The mediation model of support for the behavioral intention effect

Variable	Model 1 DV=Actual OA publication			Model 2 DV=Behavioral intentions			Model 3 DV=Actual OA publication		
	β	<i>t</i>	<i>p-value</i>	β	<i>t</i>	<i>p-value</i>	β	<i>t</i>	<i>p-value</i>
Performance Expectancy (PE)	.170	2.258	.025	.174	2.447	.015	.152	1.993	.048
Effort Expectancy (EE)	-.089	-.990	.324	.029	.339	.735	-.092	-1.025	.307
Social Influence (SI)	.133	2.002	.047	.162	2.564	.011	.117	1.726	.086
Facilitating Conditions (FC)	.087	.962	.337	.169	1.982	.049	.069	.762	.447
Attitude (Atti)	.120	1.780	.084	.303	4.463	.000	.089	1.188	.236
Self-Efficacy (SE)	-.168	-2.438	.016	-.015	-.232	.817	-.166	-2.420	.016
Anxiety (ANX)	-.011	-.165	.869	-.041	-.664	.508	-.006	-.100	.920
Voluntariness of publicity (VoP)	.427	6.746	.000	.099	1.640	.103	.417	6.554	.000
Awareness (AWA)	.012	.206	.837	.007	.137	.891	.011	.193	.847
Cognitive flexibility (CF)	.110	1.884	.061	.091	1.646	.101	.100	1.715	.088
<i>Behavioral Intentions (BI)</i>		--			--		.103	1.351	.178
	$R^2 = .396, F(10,191) = 12.57, p = 000$			$R^2 = .456, F(10,191) = 16.03, p = 000$			$R^2 = .402, F(11,190) = 11.59, p = .000$		

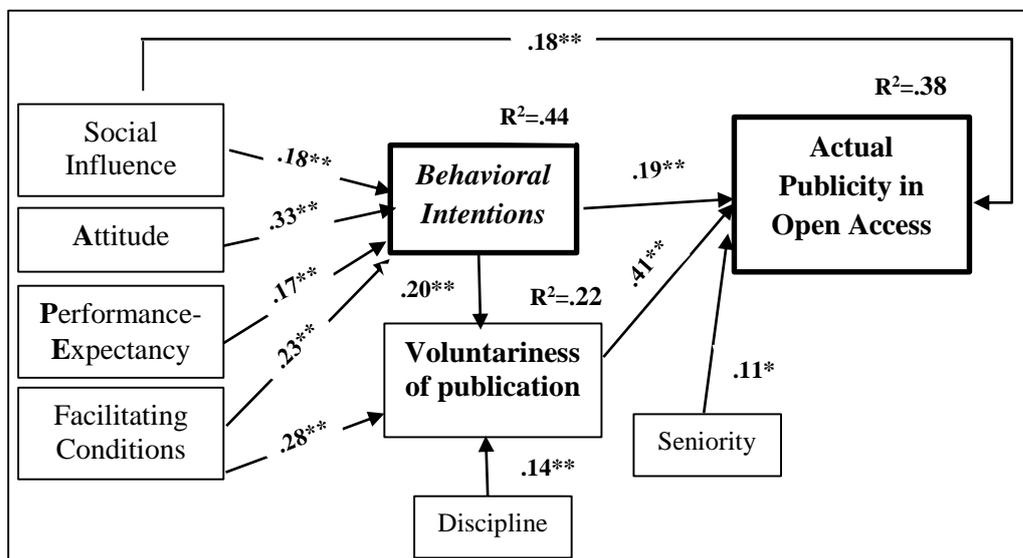
Note: Boldface entries are unstandardized coefficients and reflect statistically significant coefficients

At the first step (Model 1), PE, SI, attitude (marginally significant), and VoP were significant and positive predictors, while SE was a negative predictor (against the hypothesis) of OPiOA. Regarding the second of the four-step model, a linear regression was performed to predict researchers' OAiOA based on their BI. A significant regression equation was found ($F(1,200) = 39.69, p = .000$), with an R^2 of .166. BI significantly predicted the APiOA level, $\beta = .407, t = 6.30, p = .000$. In the third step (Model 2), PE, SI, FC and Attitude significantly and positively predicted BI. Voluntariness and SE were found to be non-significant variables; therefore, they did not comply with the mediation model conditions. In the fourth and final stage (Model 3), which included the mediator, the coefficient of PE and SI was reduced and

indicated a partial mediation effect. Including the mediator nullified the direct relationship between attitude and APiOA and indicated a full mediation. Interestingly, SE was still a negative significant variable. Moreover, researcher BI was found as a non-significant predictor variable, and the most powerful predictor – voluntariness – was significantly and positively predicted APiOA level. These findings suggest the need for further testing of the existence of an additional mediating variable. Several experts (Cheung *et al.*, 2021; Hadi *et al.*, 2016; Pardo and Román, 2013) recommended using (SEM) that allow incorporating more than one mediator into the analysis. According to Pardo and Román (2013), the proof of mediation does not require starting with the significant relationship between the independent and dependent variables. Hence, when we evaluated the first model (Model A, Table 3), all variables demonstrated the hypothesized model (Figure 1). Next, according to Hair *et al.*'s (2014) proposal, when the direct paths were significant, the mediating variable was included, and the bootstrapping procedure was conducted again. Three iterations were required following these roles and results of the chi-square test and the fit and modification indices. The final model illustrating in Figure2, suggested an excellent fit between the model and data from the sample ($Chi^2_{(14)} = 14.84$, $p = .39$, $GFI = .99$, $IFI = .99$, $NFI = .97$, $CFI = .98$, $RMSEA = .017$). The standardized path coefficients and R^2 values for the modified model are presented in Figure 2 as the most useful for comparing the relative strength of paths within a given path diagram.

Figure 2

Standardized Regression Weights – Paths diagram



Notes. a. Significant path ($p < .05$) coefficients in the model. b. Discipline coded: 1=social and humanities; 2 = STEM. c. Seniority coded: 1= 3 years and below...5 = 16 years and above.

The results of mediation analysis using structural equation modeling showed a multiple mediation model. Both, BI and VoP were mediator variables. BI mediated the association between researchers' perceptions, namely: SI (which, in addition, had a significant direct prediction effect on researcher OPiOA), attitude, PE, and FC. Moreover, researchers' BI

themselves were mediated by researchers' VoP in OA. This step explained 44% of the variance in the level of APiOA. The second mediator is VoP, which mediated the association between FC, the discipline, and the APiOA, and explained 22% of the variance. Thus, the more support researchers receive and are from a STEM field, the greater their tendency to publish in OA, which is mediated by their personal choice to publish in OA. Seniority directly predicted APiOA, so the more senior the researchers, the more they publish in OA. Altogether, these variables explained 38% of variance of APiOA.

In order to investigate the specific indirect effect associated with each mediator, we first multiplied each mediation pathway. The bootstrap procedure produced bias-corrected confidence intervals for $a*b$ and with 2 mediators' paths for $a*b*c$, based on 5,000 bootstrap samples. Table 4 presents bootstrap estimation of the specific indirect effects (unstandardized) of BI and VoP on APiOA with standard errors and 95% confidence bounds. Finally, the variance accounted for (VAF) was calculated for measuring the mediating effect size.

Table 4

Bootstrap estimates of the specific indirect effects of behavioral intentions and voluntariness of publication on OA publication level

Structural Path	Indirect Effects			p-value	VAF
	Estimate	Bais-corrected bootstrap 95% confidence interval			
		Lower	Upper		
Atti → BI → APiOA	.044	.013	.090	.005	21.03%
PE → BI → APiOA	.021	.005	.047	.005	20.08%
SI → BI → APiOA	.030	.007	.074	.009	21.19%
FC → BI → APiOA	.028	.008	.057	.004	21.29%
BI → VoP → APiOA	.087	.028	.166	.003	29.28%
Atti → BI → VoP → APiOA	.019	.006	.042	.003	7.56%
PE → BI → VoP → APiOA	.009	.002	.023	.004	7.77%
SI → BI → VoP → APiOA	.013	.002	.035	.009	7.89%
FC → BI → VoP → APiOA	.012	.004	.027	.002	7.63%
FC → VoP → APiOA	.073	.031	.127	.001	28.20%
Discipline → VoP → APiOA	.085	.006	.182	.035	28.50%

Notes: a. VAF = indirect effect / total effect * 100 b. Attitude = Atti, PE = Performance Expectancy, SI=Social Influence, FC=Facilitating Conditions (FC), BI=Behavioral Intentions, VoP = Voluntariness of Publication, APiOA=Actual Publication in Open-Access.

As seen in Table 4, the indirect effect pathways were significant. Hence, the constituent paths for a hypothesized indirect effect through both mediation variables, BI and VoP, were deemed to be mediators of the effects on researchers' APiOA. Regarding the strength of mediation, as suggested by Hair et al. (2014), a VAF value between 20% and 80% is partial mediation in the structural model. In view of this, the mediating effect of VoP between BI, FC,

discipline, and APiOA was found to be partial but stronger than the partial mediating effect of *BI* between Atti, PE, SI, and FC. Although all the indirect paths were significant, according to Hair et al.'s (2014) rule, a value less than 20% means there is no mediation. Therefore, it was concluded that there is no “double mediating effect” of VoP and BI between Atti, PE, SI, FC, and APiOA.

Differences Among-Researchers as a Function of Their Socio-Demographic Variables

Finally, in order to examine the differences between researchers in their APiOA, t-test for independent groups and one-way ANOVA were conducted. Regarding gender, there was a significant effect for gender, $t(200) = -3.171, p = .002$. Males ($M = 2.65, SD = 1.58$) have significantly more OA publications than females ($M = 2.03, SD = 1.19$). A significant effect was also found regarding discipline, $t(200) = -3.153, p = .002$. STEM researchers ($M = 2.75, SD = 1.66$) have significantly more OA publications than their counterparts in the social sciences and humanities ($M = 2.10, SD = 1.32$). Among the 96 (47.5%) STEM researchers, 73 (76%) published articles in OA journals, and 72 (75%) archived publications in an OA repository. On the other hand, among the 106 (52.5%) social and humanities researchers only 43 (40.6%) published articles in OA journals, and 54 (50.9%) archived publications in an OA repository, according to their report.

The main effect of researcher rank was not significant, $F(5, 196) = 1.923, p = .092$. Assistant lecturers, lecturers, senior lecturers, associate professors and professors, did not significantly differ in their APiOA. In addition, tenure status' main effect was not found significant, $F(2, 199) = 1.785, p = .170$. Although there is an increase between the groups with regard to tenure status, researchers who were not candidates for tenure ($M = 1.87, SD = 1.29$), do not significantly differ from those who were candidates for tenure ($M = 2.45, SD = 1.40$) or in the status of tenure ($M = 2.50, SD = 1.53$) in their APiOA. Finally, the main effect of seniority was found significant, $F(4, 197) = 3.195, p = .014$. Pairwise comparisons with Bonferroni Correction, showed that researchers with 11-15 years of seniority ($M = 2.69, SD = 1.22$), publish significantly more articles in OA than those with 4-6 years ($M = 1.47, SD = 1.52$).

Discussion

The current study examined researchers' perceptions, attitudes, and awareness from various research disciplines, concerning scientific publications in OA journals and repositories. The participants were 202 Israeli researchers, 106 (52.5%) from the social sciences and humanities, and 96 (47.5%) were from the Exact Sciences/STEM. Among the STEM researchers, more than 75% published/deposited in OA journal/repositories, compared to less than 51% among social science and humanities researchers. The main aims of this research were to formulate and validate a research model regarding the acceptance and usage of OA; and to determine the

factors that lead Israeli researchers to publish in OA. In order to reach this goal, the current research used seven core factors from the UTAUT model (Venkatesh *et al.*, 2003).

Factors Affecting Researcher's Behavioral Intentions

The first aggregation of research hypotheses (**H1_{a-g}**, **H4_a**, **H5_a** and **H6_a**) assumed an effect between research variables and the behavioral intentions to publish in OA. As expected, Performance Expectancy (PE), Social Influence (SI), Facilitating Conditions (FC), and Attitude (Atti), were significant and positively predicted researchers' BI to publish in OA. The present study's findings reinforce previous studies that have found SI, FC, and PE have a positive effect on researchers' intention to publish open articles (Lwoga and Questier, 2014; Kocaleva *et al.*, 2015). The final UTAUT model does not address individual characteristics toward BI to adopt technology (attitude, self-efficacy (SE), and anxiety). Our findings showed that attitude was central to BI and usage behaviors. There has been an ongoing debate whether OA journals are inherently of lower quality than subscription ones (Woszczynski and Whitman, 2016; Zhu, 2017). Our findings suggest that the more researchers have positive attitudes toward OA, the higher their BI and the degree of actual publications in OA. However, as Venkatesh *et al.* (2003, 2012) found, anxiety and SE have an indirect effect on BI through other constructs, as described below.

Anxiety (ANX) and Effort Expectancy (EE) had no effect on BI in this study. Nevertheless, both strongly associated with FC (negatively and positively, respectively). Thus, the more supportive conditions researchers have, the more they believe that OA publishing is understandable and effortless. In contrast, the more researchers believe they have no supportive conditions to publish in OA, the higher their level of anxiety. These findings suggest in addition an indirect effect between researchers' EE, anxiety, and BI through their FC. FC in the context of the present study addresses researchers' belief that there is an organizational, technical, and financial infrastructure to support publishing OA articles. These supporting conditions were found in previous studies as having an influence on their decision to publish in OA (Shamseer *et al.*, 2017; Woszczynski and Whitman, 2016). In addition, the current study revealed that women, junior academics, and those that belong to the social sciences and humanities published significantly fewer OA articles. These findings reinforce previous studies that found that the lack of helpful conditions leads to concerns about the ability to publish in OA, especially among early-career researchers, women and faculties that generally lack funds, such as social sciences, humanities, and emerging disciplines (Olejniczak and Wilson, 2020; Vuong *et al.*, 2021).

Self-Efficacy (SE) and Awareness (AWA), have no effect on BI but both were associated with a single factor: performance expectancy (PE), which indicated that the more researchers are aware of OA, and the more they believe they have the internal and external resources to publish in OA, the greater their positive expectation of performance when publishing an OA article. These findings suggest in addition an indirect effect between researchers' SE, awareness

and BI through their OA and PE. PE in the context of the present study addresses researchers' expectation of wider distribution and an increase in article citations. These expectations were found in previous studies as having a positive effect on researchers' support for OA publishing (Piwowar *et al.*, 2018; Pollock and Michael, 2019).

Factors Affecting Researcher's actual Publication in OA

The second aggregation of research hypotheses (**H2_{a-g}**, **H4_b**, **H5_b** and **H6_b**) assumed an effect between research variables and APiOA. Corresponding to the hypothesis, PE, SI, and attitude that predicted researchers' BI also predicted the factors that led researchers to publish in OA journals and repositories. Further, voluntariness of publishing (VoP) in OA, was found as the most powerful and positive predictor of APiOA. Similar to the current study, voluntary use was found to be essential to measure the intent to use the system being implemented (Venkatesh *et al.*, 2013). Cognitive flexibility (CF) for changes, was found in the present study to positively predict APiOA. CF not only addresses the ability of people to change plans and routines easily, but also to change decisions if they have benefit (Di Fabio and Gori, 2016; Wanberg and Banas, 2000).

Higher education institutions have an instrumental role in the move towards OA by shaping national strategies, policies, and agendas (Boufarss and Laakso, 2020). Therefore, the current research hypothesis was that SE—the belief that there are internal and external resources—will have a positive impact on the researchers' OA publishing level. However, and in contrast to previous studies (Venkatesh *et al.*, 2012; Yaakobi, 2018), SE predicted APiOA negatively, suggesting that researchers have a low incentive to publish OA. According to Bandura (2000), although SE beliefs underlie human functioning, “unless people believe that they can produce desired effects and forestall undesired ones by their actions, they have little incentive to act (p. 75)”.

Regarding researchers' BI to publish OA, in accordance with hypothesis **H7**, and as found in previous studies (e.g., Khechine *et al.*, 2016; Venkatesh *et al.*, 2012), BI significantly predicted APiOA. However, when the other variables were included in the regression model, BI no longer predicted APiOA. Also contrary to the hypotheses, researchers' EE, FC, anxiety, and awareness did not predict the researchers' APiOA. These findings indicate the need to re-examine the linearity of the current study hypotheses, which were based as stated on the UTAUT model. Thus, the present study used SEM to measure and analyze the direct and indirect paths in the empirical model.

From a Theoretical to an Empirical, Multiple Mediation Model

The third aggregation of research hypotheses (**H8_{a-j}**), assumed a mediation effect between the study variables and APiOA via researchers' BI. Findings from the four-step mediation

analysis model (Baron and Kenny, 1986) revealed evidence of the existence of more than one mediating variable. The results of mediation analysis using SEM showed that both behavioral intentions and voluntariness of OA publication were mediator variables. Hence, this research may conclude that APiOA level can be strengthened and enhanced by raising the level of researchers' BI, which is affected by their perceptions; the researchers' intention to publish in OA journal/database is mediated and influenced by the researchers' VoP, their self-decision to publish OA; VoP are significantly affected by the degree of supportive conditions they receive, and their affiliation with STEM domains.

Despite the recent flurry of developments and conversations around OA, and in light of funding organizations' requirements, such as plan S and Horizon2020, to publish/deposit articles in OA (Laakso *et al.*, 2021; Piwowar *et al.*, 2018), the current research findings question researchers' "voluntariness" to publish OA articles. Researchers, according to the findings of this and other studies, especially those involving the humanities and social sciences, lack budget for OA publication, have low awareness of OA, and are anxious about the implications of publishing in this way (e.g., Lwoga and Questier, 2014; Monaghan, 2020). These limitations create a self-reinforcing cycle in which well-funded researchers publish more OA articles, and may attract more attention and funding (Brainard, 2021; Halevi and Walsh, 2021). Finally, and as found in other studies, the impact of the researcher's environment and their seniority was found to have direct and indirect effects on APiOA, indicating a broad impact of these variables on the actual level of publication in OA (Halevi and Walsh, 2021; Kocaleva *et al.*, 2015).

Conclusions and Implications

The current study has contributed to the cumulative understanding of OA publicity adoption and use by Israeli researchers, and formulated and validated an empirical research model regarding its acceptance and use of OA. The OA movement is approaching a moment of great importance in the scholarly communication system (Piwowar *et al.*, 2018). Unfortunately, the concern that OA publishing will become a luxury that only better-funded researchers can afford is becoming a reality. According to the current findings and in accord with previous studies, this is especially difficult for early-career researchers, female researchers, authors who lack their own grants, and for those not in STEM disciplines that traditionally receive less funding (Olejniczak and Wilson, 2020; Zhu, 2017).

The polymorphic character of OA, as well as its terminology, create difficulties among researchers and decision-makers at state and private research institutions (Natale, 2019) in Israel and around the world. A low level of awareness, combined with a high level of anxiety regarding OA publication among Israeli researchers, suggests that researchers cannot be left alone in the battle. They need facilitating conditions, including financial and knowledge support, and conditions that allow them to self-archive articles in repositories. Universities have

to increase their presence in the OA movement. For example, transformative agreements can make a major contribution to the growth of OA, and can truly change the research landscape (Monaghan *et al.*, 2020). In addition, nationwide strategies aligned with international initiatives such as OA2020 and Plan S need to be adopted. These strategies should be translated into actionable policies and initiatives at institutional and national levels.

Limitations and Future Research

This study has several limitations. First, the study focused only on researchers in Israel, which poses a limitation about the results' generalizability to other countries. Cross-cultural comparisons of the validity of the proposed model in different countries would be useful theoretically and practically. Second, although this study attempted to cover major predictors, there may be other factors (barriers as well as advantages) that also contribute towards publishing in OA journals and repositories. Finally, it should be taken into consideration that this study was based on self-reported methodology. Further studies may expand the researchers' sample, and crosscheck researchers, librarians, and policymakers' perspectives. Large-scale bibliometric analyses can strengthen the validity of the findings.

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