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ENHANCING VOLUNTEERS' INTENTION TO ENGAGE IN CITIZEN SCIENCE: THE ROLES OF SELF-EFFICACY, SATISFACTION AND SCIENCE TRUST

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Abstract. *This research was carried out at the Science Volunteer Program 2018, which is run by Taiwan's Ministry of Science and Technology. The purpose of the research was to understand the effects of self-efficacy, satisfaction, and science trust on science volunteers' intention to continue volunteering. The research drew on the Social Cognitive Career Theory (SCCT) to test how social cognitive variables affect volunteers' intention to continue engaging in events and with organizations. A total of 156 volunteers taking part in the program completed a questionnaire measuring Self-efficacy, Satisfaction, Trust, and Intention. A structural equation model (SEM) was developed, and the proposed effects on the variables were tested using SEM procedures. The results of the SEM analysis found that there were positive effects between (a) Self-efficacy and Satisfaction, (b) Self-efficacy and Intention, (c) Satisfaction and Intention, and (d) Trust and Intention. The discussion highlights implications for science volunteer managers who are not only in a position to increase volunteers' behavioral intention to continue their engagement in volunteer work, but also to facilitate interventions to boost volunteering in Taiwan.*

Keywords: *citizen science, science volunteers, social cognitive career theory, structural equation model*

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Introduction

There is a traditional stereotype that the tasks volunteers perform tend to be simple and unimportant, such as giving directions and distributing leaflets. However, in recent years there has been growing interest in recruiting volunteers for citizen science projects to take part in scientific studies (Aristeidou, Scanlon, & Sharples, 2017; Chien, 2017); accordingly, there has been continued growth in the involvement of the general public in shared scientific activities and science understanding (Aristeidou, Scanlon, & Sharples, 2017). The benefits of public engagement (PE) include (i) contributing to building a more scientifically literate society, (ii) injecting differing perspectives and creativity into research design and results, and (iii) fostering more societally relevant and desirable research and innovation outcomes (Martin, 2017). For example, one of the most successful cases of public engagement in science is bird monitoring. Dating back to the 17th century, the global knowledge of changes in bird populations in many regions increased due to volunteer programs (Lepage & Francis, 2002; van der Velde et al., 2017). This knowledge was then applied in conservation efforts. Citizen science, a construct which has a number of definitions, is one way in which the public can engage directly in science.

In line with many Western countries' studies on citizen science, Kobori et al. (2016) defined it as public engagement in scientific projects; this definition is now generally accepted by a growing number of citizen science researchers and practitioners. Within the United Kingdom, the Biological Records Centre (BRC) cooperates with the community of volunteers by supporting national recording schemes (i.e., an example of citizen science) and through analysis and reporting, adds value to the data. This recording of biological data covers a wide variety of activities, and every year involves approximately 70,000 volunteers in the United Kingdom, ranging from expert volunteers who perform systematic monitoring to the general public who take part in recording data (Pocock, Roy, Preston, & Roy, 2015). Moreover, the long history of citizen science in biological recording in the United States is widely

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recognized as playing a vital role in science and decision-making (Dickinson, Zuckerberg, & Bonter, 2010) and there are now dozens of formal programs. Programs in both the United Kingdom and the United States target both birds and other appealing animals, including amphibians and butterflies. Asia also boasts a long history of public involvement in recording scientific data. An example is the 1,200 years of records of the dates of the cherry blossom season in Kyoto, Japan. These records have been kept for so long that they have provided a useful reference for climate reconstructions (Aono & Kazui, 2008). Furthermore, in China, data collected by local citizens have facilitated improvements in water quality and have been able to provide important information on the impact of atmospheric aerosols on health, climate, and air traffic over the years (Thornhill et al., 2017). Particularly, in recent years there has been significant growth in both the scale and the range of projects involving technology-mediated social participation (TMSP) (Kraut et al., 2010), including Wikipedia, Linux, and CiteULike. This kind of online citizen science project provides a venue where those people who are interested can contribute to scientific research via the Internet. These projects reduce the costs of scientific research, increase the research teams' resources, foster partnerships between citizens and scientists, and enhance the public's understanding of science (Nov, Arazy, & Anderson, 2014). According to the literature, citizen science projects can adopt a variety of approaches, have different goals, and relate to a range of science disciplines.

However, one of the most important challenges faced in the design of citizen science systems is how to recruit and retain participation over an extended time frame. Failure to retain volunteers not only adversely impacts the event, but also means that the organizations have to put extra effort into recruiting and training new volunteers (Ferreira, Proenca, & Proenca, 2015; Kim, Trail, Lim, & Kim, 2009). Therefore, this research aimed to identify science volunteer service contributions to volunteers and their intention to continue their engagement in volunteer programs. In order to effectively fill the demand-supply gap of future volunteers, it is important for both scholars and practitioners to have a clear understanding of exactly which factors stimulate volunteers' intention to continue their engagement in science volunteer programs (Ganzevoort, van den Born, Halffman, & Turnhout, 2017; Land-Zandstra, Devilee, Snik, Buurmeijer, & van den Broek, 2016). Knowing what the mechanisms are that underlie these factors can guide the training and professional development of volunteers and can help us better understand how volunteering affects the intentions of volunteers to continue their involvement. Studies have found that volunteers with positive social-cognitive variables make more novel contributions to volunteer-based citizen science projects, such as enhanced participation frequency, as well as increased and longer participation (Tiago, Gouveia, Capinha, Santos-Reis, & Pereira, 2017). Among these social-cognitive variables, the most important is self-efficacy because of its significant impact on individuals' feelings, thoughts, motivations, and behavior. Bandura (1986) noted that self-efficacy expectations refer to how successfully individuals believe that they can perform a particular task or behavior. In this context, it means that science volunteers who have more confidence that they can successfully perform scientific tasks are more likely to continue their volunteer work in the future. Meanwhile, Wright, Underhill, Keene, and Knight (2015) suggested that volunteer satisfaction in citizen science projects can act as an incentive for increased volunteers' longevity of service and intention to continue volunteering. In other words, repeated engagement in an experience or behavior and how long the volunteer services continue can be reliably predicted by volunteer satisfaction. Therefore, Self-efficacy and Satisfaction can explain the intention to continue volunteering, a critical predictor of actual volunteer retention.

Furthermore, it is generally considered that participation in citizen science projects will lead to increased science knowledge and can act as an incentive for increased scientific engagement and awareness. In the last decade, it has been shown that trust has a fundamental influence on students' acceptance and adoption of scientific knowledge (Jack, Lee, Yang, & Lin, 2017; Roberts, Reid, Schroeder, & Norris, 2013). These studies have provided evidence that students who take part in STEM enrichment programs are more likely to identify with science, to exhibit positive attitudes toward science, and to have a high level of credibility in science. Ravetz and Saltelli (2015) also argued that regular learning about scientific advancements may bolster trust in science. There seems to be an increased possibility of at least some form of civic engagement by students due to their engagement in science learning programs. Given the context of the benefits of science volunteering, Science trust could reduce uncertainty in science-mediated environments and is therefore a vital requirement for all future and current volunteers. That is to say, the more the volunteers trust science, the more they will intend to volunteer in citizen science projects. Unfortunately, there has been little research on the impact of Science trust on the probability that volunteers will continue their engagement in volunteer programs (Martin, 2017). This research therefore aimed to understand whether Science trust has an effect on volunteers' intention to continue their involvement in volunteer programs.

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Taking different frameworks into consideration, this research studied the effects of executive-level volunteers' Intention to Continue Volunteering as a way to encourage their involvement in a Science Volunteer Program. The official statistics of Taiwan's Ministry of Science and Technology indicate that altogether more than 1,400 volunteers, including 39 service teams, serve at a range of different locations in Taiwan. Consequently, the aim of this research was to test the effects of Self-efficacy, Satisfaction, and Science Trust on predicting Intention to Continue Volunteering and on volunteers' actual future behavior.

Literature Review

The current research was conducted to identify variables predicting the intention of science volunteers to attend a Science Volunteer Program. The social cognitive career theory (SCCT; Lent, Brown, & Hackett, 1994) constructs (Self-efficacy, Satisfaction, Intention to Continue Volunteering) and Science Trust were modified for this purpose. These hypothesized effects are described in the following paragraphs.

Self-efficacy refers to a series of self-beliefs about one's capabilities to complete goal-oriented tasks (Bandura, 1997; Betz, 2000; Gao, Lee, & Harrison, 2008). Science self-efficacy therefore refers to one's perception of one's ability to successfully complete tasks related to science. More specifically, it has been found that science self-efficacy has an influence on students' choice of science-related activities, as well as their cognitive effort and eventual successful completion of those activities (Gwilliam & Betz, 2001; Lamb, Vallett, & Annetta, 2014). For example, when individuals respond to an item such as "I do well in science," their interpretation of what "well" means will depend on their own standards and frames of reference. From a social cognitive perspective, there is a positive relationship between self-efficacy and outcome expectations including satisfaction, as supported by some research results (Erol, 2017; Perera, Granziera, & McIlveen, 2018). For instance, Collie, Shapka, and Perry (2012) found that self-efficacy may be responsible for predicting the positive effects of satisfaction. Similarly, Deitz et al. (2015) reported that increased confidence has the potential to enhance learners' satisfaction over an extended period of time after conducting a problem-solving activity. This effect may be because people generally expect to be more satisfied when performing activities for which they consider themselves to be efficacious. According to SCCT, self-efficacy is also seen as a predictor of career choice, due to students being more likely to opt for careers for which they believe they have the capabilities, while they tend not to be interested in those careers for which they lack the required skills and performance (Uitto, 2014; Zeldin, Britner, & Pajares, 2008). As well as the direct effects of self-efficacy-enhancing interventions on an individual's interests, the SCCT states that changes in self-efficacy can directly affect the individual's goals and actions. That is, when people judge their own ability to complete a task, their performance in attaining their goals can be increased. This proposition has been confirmed by research which has found that it is important to examine the construct of self-efficacy in order to understand students' intention to promote science (Bailey, Lombardi, Cordova, & Sinatra, 2017; Ucar & Sungur, 2017). In a voluntary environment, this means that the more favorable a volunteer's self-efficacy, the stronger the volunteer's intention to perform a certain behavior would tend to be.

In general, it was expected that a volunteer's participation in research would be likely to lead to stronger science self-efficacy, and that this would in turn lead to enhanced Satisfaction and Behavior intentions. Formally stated:

> Hypothesis 1: Self-efficacy has a positive effect on Satisfaction.
> Hypothesis 2: Self-efficacy has a positive effect with Behavioral intentions to continue to serve as science volunteers.

Satisfaction is not only a state of feeling that reflects the emotional and physical well-being of an individual (Heintzelman & Bacon, 2015; Weintraub, Geithner, Stroustrup, & Waldman, 2016) but is also, as Sacchetti and Tortia (2013) defined, a feeling that an individual perceives when his/her desire or need is satisfied. In accordance with SCCT, individuals are more likely to pursue occupations if they believe that they will experience positive outcomes such as satisfaction. Thus, satisfaction should be considered as underlying the concept of SCCT as indicated by work and organizational psychology. Previous research has examined satisfaction in extensively studied topics such as life satisfaction (Caprara & Steca, 2005), job satisfaction (Zee & Koomen, 2016), and academic satisfaction (Duffy, Douglass, & Autin, 2015). From these different kinds of satisfaction, which are also applicable to volunteer-work settings, we can know that volunteers' satisfaction is a reflection of their volunteering feelings, beliefs, and behaviors.

Volunteer satisfaction is of utmost importance for those organizations which depend on volunteers (Finkel-

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stein, 2008; Okun, Infurna, & Hutchinson, 2016). Owing to the popularity of volunteerism, the functional approach to it proposes that intentions to continue volunteering are influenced by satisfaction with the volunteering environment. For example, to facilitate the recruitment and retention of volunteers, Pavlova and Silbereisen (2012) demonstrated not only that perceived improvement in quality of life had positive effects on satisfaction, but that people who had initially higher satisfaction with their experience and work subsequently contributed more hours of volunteer work. Wilson (2012) also suggested that volunteer managers need to decide the most effective way to ensure this kind of satisfaction, and make efforts to retain volunteers, because when volunteers are satisfied with their experience or behavior, the probability of continuing their volunteer service with the organization over an extended period of time will be higher. It is thus critical that volunteers enjoy their experience, that they receive the help they need, and that the volunteering process is effectively managed by the organization. Therefore, this research aimed to examine the importance of the design of volunteer science events, and the following hypothesis was thus proposed:

> Hypothesis 3: Satisfaction is a significant predictor of Behavioral intentions to continue to serve as science volunteers.

Trust can be defined as a complex and abstract concept; however, there is still a lack of consensus on how trust is formed and on the effect it has on behavior (Cheung & To, 2017; Jin, Bluemling, & Mol, 2015; Lin & Wang, 2015). Trust has been analyzed in previous studies from a general perspective, and subject matter trust has been shown to be positively related to the strategy and marketing literature (Gundlach & Cannon, 2010); an economic perspective (Dyer & Chu, 2011); and the organizational literature (Perry & Mankin, 2007). Overall, trust appears to have fundamental positive consequences. Although the importance of trust is well developed in business, little is known about why people have trust in science and how this trust influences behavioral intentions in the fields of education and psychology (Ravetz & Saltelli, 2015). Some studies have shown that student identification with science has increased due to their participation in STEM (science, technology, engineering, and mathematics) enrichment programs (Archer et al., 2012; Cundiff, Vescio, Loken, & Lo, 2013; Ramsey, Betz, & Sekaquaptewa, 2013). An understanding of whether students' identification with science increases their participation in STEM enrichment programs would be helpful considering the effects between science identity and intention to continue with scientific pursuits. Following a similar perspective underlying volunteerism, the current research focused on the extent to which volunteers view "science" as a core component of their trust. This conceptualization of science trust aligns with prior work such as technology trust (Hernandez-Ortega, 2011). In this research, it is considered that, if volunteers have more trust in science, they will usually be involved in citizen science. Unfortunately, the literature on the effects between trust in science and involvement in citizen science is limited (Martin, 2017). Thus, in this research, this effect was tested by examining the factors that influence volunteers' trust in science and what impacts their trust has on their intentions to continue their involvement in volunteer work. Based on the preceding discussion, the following hypothesis was drawn:

> Hypothesis 4: Science trust contributes unique variance to the prediction of Behavioral intentions to continue to serve as science volunteers.

Research Methodology

General Background

This research tested the hypotheses regarding the effects of Self-efficacy, Satisfaction, and Science Trust on predicting Intention to Continue Volunteering and on volunteers' actual future behavior. Therefore, drawing on the Social Cognitive Career Theory (SCCT), a survey design was employed, and quantitative data were collected using reliable measurement tools. A survey is an instrument designed to collect data from a whole population or part of a population to describe, compare, relate, or predict their attitudes, opinions, behaviors, characteristics, or knowledge (Creswell, 2012). The quantitative data were collected in August 2019 from volunteers enrolled in the Science Volunteer Program and serving at various sites.

In recent years, agencies in Taiwan's government as well as the National Science Council (NSC) have focused on promoting the Science Volunteer Program due to the belief that science service provides a unique context for

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the development of science, education, and the humanities. It is also believed that the employment of volunteer labor has social, psychological and educational benefits. The main aim of the program is to provide volunteers with learning experiences which can enhance and complement their formal education. A longitudinal study elicited feedback from volunteers from 39 service teams serving at different sites about the impact of their satisfaction with the Science Volunteer Program.

Sample

The participants of this research were 156 volunteers (56 male, 100 female) randomly selected from 39 Science Volunteer teams (1,000+ volunteers) in Taiwan. Regarding their service duration, 37.5% had volunteered for less than one year, 26.4% for one to three years, 15.1% for three to five years, and 21% for over five years. The participants were selected after a pilot study was carried out in March 2019. The volunteers were given a cover letter explaining the purpose of the research and a questionnaire along with the information needed to complete it.

Ethical Considerations

The volunteers of each science team gave their consent to take part in the research. They were first presented with a letter of consent detailing the nature of their involvement in the research. The purpose of the research was explained in detail and participants were assured of the confidentiality of their responses. They were informed that they could withdraw from the research without penalty. Signing the consent form indicated their full understanding of the project.

Instruments

In order to ensure that the information from the four questionnaires could be analyzed effectively, the Self-efficacy, Satisfaction, Science Trust, and Intention to Continue Volunteering scales about topics that were covered in the volunteer programs were sent to the volunteers in the sample population. As the original measurement instruments were in English, a native Chinese-speaking researcher translated them into Chinese. Upon completion, all measurement instruments were collected and examined, and missing and invalid data were removed.

The questionnaire of Self-efficacy was based on the measure developed by Lamb et al. (2014). Volunteers had to indicate their degree of confidence when they performed certain scientific tasks. This measurement instrument consists of 14 items (e.g., "I'm capable of conducting science experiments during Science Volunteer activities" and "I know how to apply scientific knowledge to Science Volunteer activities") and uses a 5-point Likert scale.

The second instrument was the Satisfaction Toward Science Service questionnaire, which was adopted from Chien (2017) and Wright et al. (2015). Satisfaction toward science service comprises six items presented as statements on a 5-point Likert scale anchored at 1 (*strongly unconfident*) to 5 (*strongly confident*) and aimed to assess the volunteers' perceived meaningful experience and their responsibility for the outcomes. Items in the questionnaire include: "I feel proud of myself when I complete my Science Volunteer tasks" and "My present job as a Science Volunteer is respected by society as a whole."

The questionnaire of Science Trust was based on the measure developed by Jack et al. (2017). This measurement instrument was used in order to obtain a relative measure of trust in science for each participating volunteer. The higher the score, the more trust the volunteer had in science-related knowledge. It consisted of 10 items (e.g., "I expect that scientists conduct experiments based on findings from a previous research so that they get a conclusion" and "I believe that findings in science studies help to improve the public's lives") and used a 5-point Likert scale.

Intentions to continue volunteering after a period of 2 years were measured using four items adapted from Kim et al. (2009) and used a 5-point scale anchored at 1 (*not at all willing*) to 5 (*very willing*), to elicit the participants' willingness to continue performing their volunteer activities. Example items include: "I will attend Science Volunteer activities regularly in the future" and "I will continue to serve as a Science Volunteer in the future."

Data Analysis

All data used for analysis were first summarized to provide descriptions of the participating science services. To test the model's validity and reliability, responses to the Self-efficacy, Satisfaction, Science Trust, and Intention

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to Continue Volunteering instruments were analyzed using exploratory factor analysis with Principal component analysis and varimax rotation. First, the items with factor loadings below 0.5 were excluded from the initial pool of items. Those items with a similarity value less than 0.5 were eliminated, as recommended by Fang et al. (2016). To construct the validity of the four questionnaires, we performed principle component analysis to estimate the number of factors, and then the effects among the variables were identified and reported. According to the primary research purposes, the statistical program for social science (SPSS) was used to analyze the questionnaire data, and factor analysis was performed for data validation. Correlation analysis and structural equation modelling (SEM) were then applied to explain the participants' intention to continue engaging in events with organizations based on the Social Cognitive Career Theory (SCCT).

Research Results

General Characteristics

This research first used the exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) to respectively clarify the structure of the volunteers' variables of the SCCT model. Then, to test the research hypotheses, structural equation model (SEM) analysis was performed to examine the structural effects between the variables. Self-efficacy, Satisfaction, and Science Trust were deemed as the predictors, while Intention to Continue Volunteering was viewed as the outcome variable.

Factor Analysis

To clarify the structure of the SCCT model variables, EFA and CFA were performed to explore the item factor structure. Only those items with loadings greater than .50 on the relevant factor and less than .50 on all other non-relevant factors were retained.

As a result of the factor analysis, the final version of Self-efficacy consisted of 14 items. The Cronbach's α coefficient of Self-efficacy was .97. The α coefficient of Satisfaction was .91. The Cronbach's α coefficient of Science Trust was .90, while the Intention to Continue Volunteering consisted of four items with an alpha value of .94. Furthermore, according to the CFA, the factor loading values for the items in the four subscales all exceeded .5, and all had significant t-values. The eigenvalue of Self-efficacy = 4.34, Satisfaction = 3.89, Science Trust = 3.75, and Intention = 3.26, which suggested a satisfactory fit and indicated acceptable construct validity of the survey items. The factor analysis results are listed in Table 1. The scales were considered to be sufficiently reliable for assessing volunteers' Self-efficacy, Satisfaction, Science Trust and Intention to Continue Volunteering to engage in science service.

Table 1
EFA and CFA of the self-efficacy, satisfaction, science trust, and intention scales

Scale	EFA (Exploratory factor analyses) CFA (Confirmatory factor analyses)		
	Cronbach α	Variance explained (%)	Composite reliability
Self-efficacy	.97	80.74	.96
Satisfaction	.91	73.56	.95
Science Trust	.90	68.85	.95
Intention	.94	78.32	.90

As shown in Table 1, the EFA results revealed the total variance explained and Cronbach's alpha coefficients, indicating good internal reliability of the four scales. Also, the CFA showed that the results have a satisfactory fit and that the survey items had good construct validity. It was therefore considered that the scales were sufficiently reliable for measuring the volunteers' Self-efficacy, Satisfaction, Science Trust and Intention in science service.

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Effects on volunteers' perceptions of engaging in science services

In order to explore the effects between volunteers' self-efficacy, satisfaction, science trust and their intention to continue with science service, the Pearson's correlation coefficients were calculated between the volunteers' responses of these variables and their intention factor. The results are presented in Table 2. The effects between self-efficacy, satisfaction, science trust and their continued intention for science service indicated that there were significant positive correlations among all of the variables (r>.42, p <.01). In general, these results supported that those volunteers who held stronger beliefs in and satisfaction with engaging in science services displayed greater persistence to carry on performing science services. In addition, volunteers' responses to continued intention showed fairly high positive correlations with self-efficacy (r>.53, p <.01), satisfaction (r>.65, p <.01) and science trust (r>.50, p <.01).

Table 2
Correlations between Self-efficacy, Satisfaction, Science Trust and Intention

	Self-efficacy	Satisfaction	Science Trust	Intention
Self-efficacy	1			
Satisfaction	.515**	1		
Science Trust	.425**	.493**	1	
Intention	.538**	.659**	.509**	1

*** p <.01*

Structural Equation Model Analysis

To test the hypothesized structural model, this research implemented SEM to explore the structural effects. This research used a fully saturated model (i.e., zero degrees of freedom) to test the hypothesized model (Figure 1) which consisted of 30 parameters. The model fit indices for this model were not examined as fully saturated models always produce a perfect fit to the data. This research used a composite variables model because it was more likely that the use of manifest variables would reflect the characteristics of the sample rather than those of the population. As a result, and referring to previous research (Burakova, Ducourneau, Gana, & Dany, 2014; Harrison, Xiao, Ott, & Bortree, 2017), a recursive path analysis model was developed. This model revealed the effects among the factors which influence volunteers' engagement in volunteering.

The SEM analysis results indicated that the indices of overall fit indicated a reasonable fit of the model (Figure 1) to the data (CMIN/DF=1.755, RMSEA = .07, CFI = .909). This means that the hypothesized model was proven to fit the data. As the figure shows, all of the path coefficients were statistically significant. First, Self-efficacy has a significant influence on Satisfaction (p<.001). Intention to Continue Volunteering has significant relations with Self-efficacy (p<.001), Satisfaction (p<.001), and Science Trust (p<.01). These results support the argument that science volunteers who express higher Self-efficacy, Satisfaction, and Science Trust display more positive Intention to Continue Volunteering. In other words, the SEM structural model results supported the hypothesis that science volunteers' Self-efficacy, Satisfaction, and Science Trust were related to their intention to participate in the science volunteer program.

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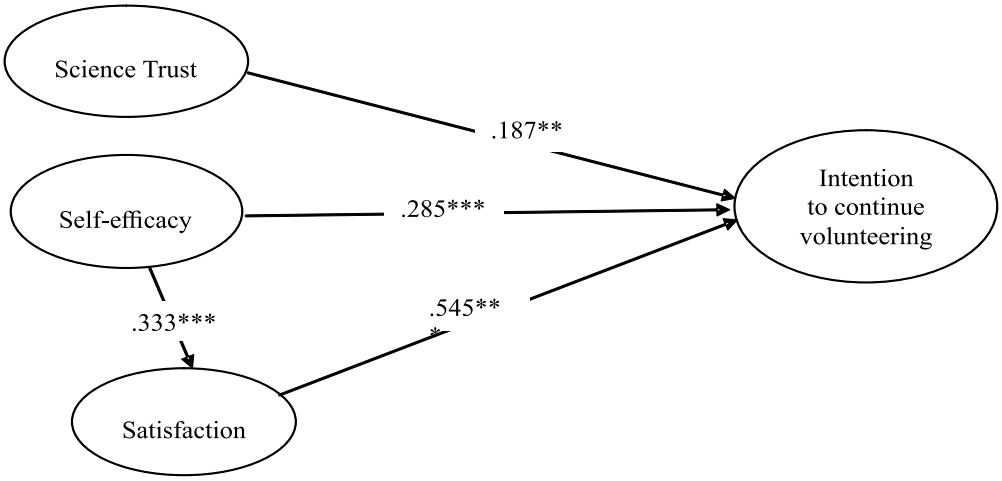
Figure 1
The research model



Discussion

Many developed countries around the world are currently finding it difficult to populate the science workforce with a sufficient number of qualified individuals via citizen science (Aono & Kazui, 2008; Dickinson et al., 2010; Pocock et al., 2015; Snik et al., 2014). These countries implement citizen science projects usually as a means of supporting competitiveness in the global economy and of developing citizens' scientific literacy participation. In Taiwan, the Science Volunteer Program (SVP), which is run by the National Science Council (NSC), offers an opportunity for volunteers and the public to participate in scientific activities and improve their ability to engage with socio-scientific issues. Similar to many citizen science projects which increase the public's understanding and support for science (Kraut et al., 2010), the subsidy process of the SVP involves a partnership between the educational institutions and non-profit organizations (NPOs). The research examines the subsidy mechanism for the NSC Science Volunteer Teams from the perspective of the NPOs. This program trains and supports dozens of multidisciplinary scientific teams involving volunteer participants who range in age from school children to adults to be promoters of science education every year. Compared to some science projects which focus on collecting process data as part of a scientific enquiry (Kobori et al., 2016), the SVP, which includes community volunteers, educators, and students, may be more involved in a variety of roles with scientists, mathematicians, and technology experts, such as experimental design, teaching, assessing their own instruction, and making modifications to improve work. Nov et al. (2014) also exhibited characteristics of a successful citizen science project, which involved a growing and sustained group of participants who were actively engaged with the community in the science project. However, successful performance of volunteer activities does not necessarily guarantee that volunteers' expectations will be met, and there are several factors which may affect volunteers' Intention to Continue Volunteering in volunteer projects on a sustained basis. Therefore, this research was designed to address a gap in the research in order to enhance our understanding of the factors which predict volunteers' intentions to engage in citizen science.

As with previous studies on volunteering (Chien, 2017; Ferreira et al., 2015; Kim et al., 2009), this research aimed to test the social-contextual factors relating to a sample of science volunteers' intention to continue volunteering. Data were obtained from 156 questionnaires via the cross-sectional method from 39 Science Volunteer Teams by using the simple random technique. Based on the literature presented in this article (Ravetz & Saltelli, 2015; Tiago et al., 2017; Wright et al., 2015), this research first examined a measurement model, including Self-efficacy, Satisfaction, and Science Trust. Following this, this research conducted SEM analyses to test the hypothesized effects of the predictors on Intention to Continue Volunteering. The results of the structural model offered an effective model fit to the data, as well as multiple supports for the hypotheses. These findings are discussed in relation to the unique context of the research and other research presented in the literature. Hence, the present research identified a set of hypotheses which have already added significant knowledge of the factors explaining sustained volunteering. A discussion of these effects based on the structural model in Figure 1 is presented in the following paragraphs.

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Hypothesis 1: Self-efficacy has a positive effect on Satisfaction.
Hypothesis 2: Self-efficacy has a positive relationship with behavioral intentions to continue to serve as science volunteers.

Both hypotheses are based on the previous research findings that the SCCT predictors are positively associated with individuals' goals or intentions (Uitto, 2014; Zeldin et al., 2008). The first hypothesis results showed that volunteers' self-efficacy for Science Volunteer activities had a positive influence on their satisfaction. That is to say, if volunteers have confidence in their understanding of the scientific knowledge related to their Science Volunteer activities, completing their Science Volunteer tasks will make them feel proud of themselves. Previous studies on the positive effects of a sense of self-efficacy on volunteering have suggested a similar pattern. According to Erol (2017) and Perera et al. (2018), if volunteers consider that their beliefs are a good match with the organization's mission, they are also more likely to report higher satisfaction with the volunteer organization. In short, volunteering satisfaction can result from volunteers' self-efficacy.

Moreover, the second hypothesis was that self-efficacy would have a direct impact on the intention to volunteer for future science service activities. This finding is in accordance with those of Bailey et al. (2017) and Ucar and Sungur (2017), who found that students' higher self-efficacy in science led them to be more passionate about future science-based activities. Usually, if individuals can conduct science experiments during their Science Volunteer activities, they will continue to serve as Science Volunteers in the future. It can therefore be seen that the SCCT model provides a theoretical framework which states that greater control beliefs will result in feeling satisfied, and that this satisfaction will in turn lead to retention with the organization.

Hypothesis 3: Satisfaction is a significant predictor of behavioral intentions to continue to serve as science volunteers.

The validation of this hypothesis supports earlier studies which showed that satisfaction is an essential factor in retaining volunteers (Pavlova & Silbereisen, 2012; Wilson, 2012). Specifically, depending on volunteers' satisfaction with the program, their level of engagement in this type of program will increase. In our research, volunteer satisfaction was shown to be a reliable predictor of repeated engagement in certain experiences or behaviors, and of long-term volunteer service. That is to say, when volunteers feel satisfied, their intention to stay will be stronger. This means that if science volunteers feel proud of themselves when they complete the Science Volunteer tasks, they will be more likely to attend Science Volunteer activities regularly in the future. As a result, volunteer satisfaction can predict Intention to Continue Volunteering to participate in science services again in the future.

Hypothesis 4: Science trust contributes unique variance to the prediction of behavioral intentions to continue to serve as science volunteers.

The hypothesis of this research supports those of some of the previous studies which found a positive association between volunteers' Science Trust and their intention to volunteer (Martin, 2017). The findings of this research indicate that the science volunteers were positively motivated across cases, either intrinsically or due to their personal trust, meaning that if they think all scientific data are objective and reliable, they will have greater willingness to attend Science Volunteer activities rather than other activities in the future. Although Science Trust played a marginally significant role in predicting Intention to Continue Volunteering compared to the previous hypotheses mentioned above, Ravetz and Saltelli (2015) also found that public trust in science is a potential factor which influences individuals' behavior. Thus, these few studies and the result of this research have consolidated the important role of Science Trust in encouraging ongoing engagement among volunteers.

In a theoretical discussion of the creation of new ventures based on an interpretation of these results, it was found that Satisfaction had the highest scores in the current research and differed markedly from the other variables in the traditional SCCT model as found by other researchers (Bailey et al., 2017; Ucar & Sungur, 2017) who have suggested that Self-efficacy is the most significant predictor and the major component of the SCCT model. One possible reason for this is that our data only included a small portion of volunteers in the Science Volunteer Program, which may reinforce the result that satisfaction is higher than in other studies.

In conclusion, the results provide strong support for the hypothesized effects among the SCCT predictors, Science Trust and Intention to Volunteer. These contributions provide a useful framework to explain the process of

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volunteers' intentions. Finally, it has been observed that there are important practical implications of these findings as they provide starting points for volunteer managers and science volunteers to be effective in their recruitment and retention efforts.

Conclusions and Implications

Nowadays, citizen science programs provide a good platform for stimulating citizens' sense of social responsibility, thus enhancing their public science knowledge. However, Science Volunteer projects in Taiwan are still in the development stage compared to other developed countries, and some problems could be inextricably linked to retaining current volunteers in nonprofit organizations requiring lower costs of recruitment, selection, and training. In practice, it is more cost-effective as well as more managerially advantageous to have volunteers return for future events than it is to recruit new volunteers. With the aim of attracting experienced volunteers to engage in science volunteering again, there are several implications of the above findings that can be used to design counseling interventions focused on increased science self-efficacy, satisfaction, and science trust by the volunteer manager. First, science self-efficacy-enhancing interventions could be presented in science courses in the hope of increasing the interest in science-related activities of young volunteers who possess skills in the science domains. Successfully tracking adjustments in volunteers' science self-efficacy could affect science volunteer retention and encourage students to continue with their science education in the field.

Second, given the importance of satisfaction for the intention of behavior, it follows that cognitive interventions designed to retain volunteers and encourage frequent participation may be appropriately focused on strengthening satisfaction. As self-efficacy can predict satisfaction and the intention to continue volunteering, it is essential for volunteer managers to take self-efficacy into account in order to design volunteer programs which can give them a sense of achievement and a feeling of fulfillment. Particularly, any gaps between the volunteers' expectations of the organization and what the organization actually aims to do can be identified, as such gaps could lead to lower frequency of attendance if the level of satisfaction is low. Implementing this intervention is a pragmatic approach to improving volunteer recruitment, retention, personal growth, and performance quality for satisfied volunteers.

Finally, the research findings indicated that volunteers' trust in science positively predicted their retention in volunteering. If the aim is to increase the rate of participation in science events, volunteer managers should target their recruitment efforts on improving science trust in generalized science process tasks. In fact, some volunteers who are afraid of science may have reduced science trust because of their previous poor academic performance in school. Therefore, it would be beneficial to design interventions within a science education setting such as a training program. This intervention should emphasize how to turn the volunteers' life experience into a science concept for attracting, satisfying, and retaining volunteers and to avoid stress and anxiety in relation to science. In summary, the recruitment of younger populations and the retention of qualified volunteers would ameliorate the volunteer shortage through these useful interventions.

Limitations and Directions for Future Research

The advantages of this research setting have already been discussed, but there are several potential limitations to the research that should be acknowledged. Suggestions to guide future research are also provided below. First, one of the difficulties encountered in this research was how to ensure the convenience of respondents when they filled out the questionnaire; thus, the length of the questionnaire was limited. As the questionnaires were subsequently delivered through the Science Volunteer Team leaders to their volunteers, it was not easy to collect more responses because each Science Volunteer Team had different concerns and situations. Therefore, the respondents did not represent a large portion of the volunteers in the Science Volunteer Teams. This resulted in a response bias to some extent due to the fact that most of the registered volunteers in the mailing list are inactive. To cover more volunteers from the sampling population, future research should cooperate with Science Volunteer Teams by sponsorship evaluation of whether the Science Volunteer Program provides funds to their team. This improvement would lead to a larger sample size and increased generalizability of the findings. Additionally, current research may include few factors with volunteering in the model. This may have resulted in limitations to the construct validity and could therefore have influenced the results, as there may be a certain amount of instability in the demonstrated effects. According to SCCT, gender-role perceptions or environmental barriers and supports are also important variables that influence the career attitude and status of an individual. It would be useful to

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incorporate longitudinal designs to examine the temporal relations among social-cognitive variables. Therefore, future research may expand the theoretical model by incorporating other factors influencing the quality of volunteer intention to Continue Volunteering.

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References

Aono, Y., & Kazui, K. (2008). Phenological data series of cherry tree flowering in Kyoto, Japan, and its application to reconstruction of springtime temperatures since the 9th century. *International Journal of Climatology*, *28*(7), 905-914.

Archer, L., DeWitt, J., Osborne, J., Dillon, J., Willis, B., & Wong, B. (2012). Science aspirations, capital, and family habitus: How families shape children's engagement and identification with science. *American Educational Research Journal*, *49*(5), 881-908. https://doi.org/10.3102%2F0002831211433290

Aristeidou, M., Scanlon, E., & Sharples, M. (2017). Profiles of engagement in online communities of citizen science participation. *Computers in Human Behavior*, *74*, 246-256. https://doi.org/10.1016/j.chb.2017.04.044

Bailey, J. M., Lombardi, D., Cordova, J. R., & Sinatra, G. M. (2017). Meeting students halfway: Increasing self-efficacy and promoting knowledge change in astronomy. *Physical Review Physics Education Research*, *13*(2), 1-19. https://doi.org/10.1103/PhysRevPhysEducRes.13.020140

Bandura, A. (1986). *Social foundation of thought and action: A social-cognitive view*. Englewood. Cliffs, NJ: Prentice-Hall.

Bandura, A. (1997). *Self-efficacy: The exercise of control*: Macmillan.

Betz, N. E. (2000). Self-efficacy theory as a basis for career assessment. *Journal of Career Assessment*, *8*(3), 205-222.

Burakova, M., Ducourneau, J., Gana, K., & Dany, L. (2014). Predicting intention to leave among volunteer fire-fighters in France. *Psychologie Francaise*, *59*(4), 273-299. https://doi.org/10.1016/j.psfr.2013.12.002

Caprara, G. V., & Steca, P. (2005). Self-efficacy beliefs as determinants of prosocial behavior conducive to life satisfaction across ages. *Journal of Social and Clinical Psychology*, *24*(2), 191-217.

Cheung, M. F. Y., & To, W. M. (2017). The influence of the propensity to trust on mobile users' attitudes toward in-app advertisements: An extension of the theory of planned behavior. *Computers in Human Behavior*, *76*, 102-111. https://doi.org/10.1016/j.chb.2017.07.011

Chien, H. M. (2017). A research of volunteers' science service satisfaction in relation to their self-directed learning and motivation. *Journal of Baltic Science Education*, *16*(2), 188-198.

Collie, R. J., Shapka, J. D., & Perry, N. E. (2012). School climate and social–emotional learning: Predicting teacher stress, job satisfaction, and teaching efficacy. *Journal of Educational Psychology*, *104*(4), 1189-1204.

Cundiff, J. L., Vescio, T. K., Loken, E., & Lo, L. (2013). Do gender-science stereotypes predict science identification and science career aspirations among undergraduate science majors? *Social Psychology of Education*, *16*(4), 541-554. https://doi.org/10.1007/s11218-013-9232-8

Deitz, S. L., Anderson, J. R., Johnson, M. D., Hardy, N. R., Zheng, F. M., & Liu, W. L. (2015). Young romance in China: Effects of family, attachment, relationship confidence, and problem solving. *Personal Effects*, *22*(2), 243-258. https://doi.org/10.1111/pere.12077

Dickinson, J. L., Zuckerberg, B., & Bonter, D. N. (2010). Citizen science as an ecological research tool: challenges and benefits. *Annual Review of Ecology, Evolution, and Systematics*, *41*, 149-172.

Duffy, R. D., Douglass, R. P., & Autin, K. L. (2015). Career adaptability and academic satisfaction: Examining work volition and self-efficacy as mediators. *Journal of Vocational Behavior*, *90*, 46-54. https://doi.org/10.1016/j.jvb.2015.07.007

Dyer, J. H., & Chu, W. (2011). The determinants of trust in supplier-automaker effects in the US, Japan, and Korea. *Journal of International Business Studies*, *42*(1), 10-27.

Erol, M. (2017). Adolescent life satisfaction before young adulthood: The role of "shyness" and "self-Efficacy". *Turk Psikiyatri Dergisi, 28*(2), 95-103.

Fang, S. C., Yu, T. K., Yu, T. Y., & Chang, I. C. (2016). Psychological Distance and Pro-Environmental Behavior: An Application Of Behavior Model To. *Journal of Baltic Science Education, 15*(6), 759.

Ferreira, M. R., Proenca, T., & Proenca, J. F. (2015). Volunteering for a lifetime? Volunteers' intention to stay in Portuguese hospitals. *VOLUNTAS: International Journal of Voluntary and Nonprofit Organizations*, *26*(3), 890-912.

Finkelstein, M. A. (2008). Volunteer satisfaction and volunteer action: a functional approach. *Social Behavior and Personality*, *36*(1), 9-17.

https://doi.org/10.33225/jbse/20.19.234

Ganzevoort, W., van den Born, R. J. G., Halffman, W., & Turnhout, S. (2017). Sharing biodiversity data: citizen scientists' concerns and motivations. *Biodiversity and Conservation, 26*(12), 2821-2837. https://doi.org/10.1007/s10531-017-1391-z

Gao, Z., Lee, A. M., & Harrison, L. (2008). Understanding students' motivation in sport and physical education: From the expectancy-value mode and self-efficacy theory perspectives. *Quest*, *60*(2), 236-254.

Gundlach, G. T., & Cannon, J. P. (2010). "Trust but verify"? The performance implications of verification strategies in trusting effects. *Journal of the Academy of Marketing Science*, *38*(4), 399-417.

Gwilliam, L. R., & Betz, N. E. (2001). Validity of measures of math- and science-related self-efficacy for African Americans and European Americans. *Journal of Career Assessment*, *9*(3), 261-281.

Harrison, V. S., Xiao, A. L., Ott, H. K., & Bortree, D. (2017). Calling all volunteers: The role of stewardship and involvement in volunteer-organization effects. *Public Relations Review*, *43*(4), 872-881. https://doi.org/10.1016/j.pubrev.2017.06.006

Heintzelman, S. J., & Bacon, P. L. (2015). Relational self-construal moderates the effect of social support on life satisfaction. *Personality and Individual Differences*, *73*, 72-77.

Hernandez-Ortega, B. (2011). The role of post-use trust in the acceptance of a technology: Drivers and consequences. *Technovation*, *31*(10-11), 523-538.

Jack, B. M., Lee, L., Yang, K. K., & Lin, H. S. (2017). A science for citizenship model: Assessing the effects of benefits, risks, and trust for predicting students' interest in and understanding of science-related content. *Research in Science Education*, *47*(5), 965-988. https://doi.org/10.1007/s11165-016-9535-9

Jin, S. Q., Bluemling, B., & Mol, A. P. J. (2015). Information, trust and pesticide overuse: Interactions between retailers and cotton farmers in China. *Njas-Wageningen Journal of Life Sciences*, *72-73*, 23-32.

Kim, M., Trail, G. T., Lim, J., & Kim, Y. K. (2009). The role of psychological contract in intention to continue volunteering. *Journal of Sport Management*, *23*(5), 549-573.

Kobori, H., Dickinson, J. L., Washitani, I., Sakurai, R., Amano, T., Komatsu, N., Miller-Rushing, A. J. (2016). Citizen science: a new approach to advance ecology, education, and conservation. *Ecological Research*, *31*(1), 1-19.

Kraut, R., Maher, M. L., Olson, J., Malone, T. W., Pirolli, P., & Thomas, J. C. (2010). Scientific foundations: A case for technology-mediated social-participation thery. *Computer*, *43*(11), 22-28.

Lamb, R. L., Vallett, D., & Annetta, L. (2014). Development of a short-form measure of Science and Technology self-efficacy using rasch analysis. *Journal of Science Education and Technology*, *23*(5), 641-657.

Land-Zandstra, A. M., Devilee, J. L. A., Snik, F., Buurmeijer, F., & van den Broek, J. M. (2016). Citizen science on a smartphone: Participants' motivations and learning. *Public Understanding of Science*, *25*(1), 45-60. https://journals.sagepub.com/home/pus

Lent, R. W., Brown, S. D., & Hackett, G. (1994). Toward a unifying social cognitive theory of career and academic interest, choice, and performance. *Journal of Vocational Behavior*, *45*(1), 79-122.

Lepage, D., & Francis, C. M. (2002). Do feeder counts reliably indicate bird population changes? 21 years of winter bird counts in Ontario, Canada. *Condor*, *104*(2), 255-270.

Lin, M. J., & Wang, W. T. (2015). Explaining online customer repurchase intentions from a relationship-marketing perspective: An integration of the 4Rs marketing strategy and customer trust. *Journal of Organizational and End User Computing*, *27*(3), 1-26. https://doi.org/10.4018/joeuc.2015070101

Martin, V. Y. (2017). Citizen science as a means for increasing public engagement in Science: Presumption or possibility? *Science Communication*, *39*(2), 142-168.

Nov, O., Arazy, O., & Anderson, D. (2014). Scientists@Home: What drives the quantity and quality of online citizen science participation? *Plos One*, *9*(4), e90375.

Okun, M., Infurna, F. J., & Hutchinson, I. (2016). Are volunteer satisfaction and enjoyment related to cessation of volunteering by older adults? *Journals of Gerontology Series B-Psychological Sciences and Social Sciences*, *71*(3), 439-444.

Pavlova, M. K., & Silbereisen, R. K. (2012). Participation in voluntary organizations and volunteer work as a compensation for the absence of work or partnership? Evidence from two German samples of younger and older adults. *Journals of Gerontology Series B-Psychological Sciences and Social Sciences*, *67*(4), 514-524.

Perera, H. N., Granziera, H., & McIlveen, P. (2018). Profiles of teacher personality and relations with teacher self-efficacy, work engagement, and job satisfaction. *Personality and Individual Differences*, *120*, 171-178. https://doi.org/10.1016/j.paid.2017.08.034

Perry, R. W., & Mankin, L. D. (2007). Organizational trust, trust in the chief executive and work satisfaction. *Public Personnel Management*, *36*(2), 165-179.

Pocock, M. J. O., Roy, H. E., Preston, C. D., & Roy, D. B. (2015). The biological records centre: A pioneer of citizen science. *Biological Journal of the Linnean Society*, *115*(3), 475-493. https://doi.org/10.1111/bij.12548

Ramsey, L. R., Betz, D. E., & Sekaquaptewa, D. (2013). The effects of an academic environment intervention on science identification among women in STEM. *Social Psychology of Education*, *16*(3), 377-397.

Ravetz, J., & Saltelli, A. (2015). The future of public trust in science. *Nature*, *524*, 161.

Roberts, M. R., Reid, G., Schroeder, M., & Norris, S. P. (2013). Causal or spurious? The relationship of knowledge and attitudes to trust in science and technology. *Public Understanding of Science*, *22*(5), 624-641.

Sacchetti, S., & Tortia, E. C. (2013). Satisfaction with creativity: A Research of organizational characteristics and individual motivation. *Journal of Happiness Studies*, *14*(6), 1789-1811. https://doi.org/10.1007/s10902-012-9410-y

Snik, F., Rietjens, J. H. H., Apituley, A., Volten, H., Mijling, B., Di Noia, A., Heikamp, S., Heinsbroek, R. C., Hasekamp, O. P., Smit, J. M., Vonk, J., Stam, D. M., van Harten, G., de Boer, J., Keller, C. U., & 3187 iSPEX citizen scientists. (2014). Mapping atmospheric aerosols with a citizen science network of smartphone spectropolarimeters. *Geophysical Research Letters*, *41*(20), 7351-7358.

https://doi.org/10.33225/jbse/20.19.234

ISSN 1648–3898 /Print/
ISSN 2538–7138 /Online/

Thornhill, I., Ho, J. G., Zhang, Y., Li, H., Ho, K. C., Miguel-Chinchilla, L., & Loiselle, S. A. (2017). Prioritising local action for water quality improvement using citizen science; a research across three major metropolitan areas of China. *Science of the Total Environment*, *584*, 1268-1281. https://doi.org/10.1016/j.scitotenv.2017.01.200

Tiago, P., Gouveia, M. J., Capinha, C., Santos-Reis, M., & Pereira, H. M. (2017). The influence of motivational factors on the frequency of participation in citizen science activities. *Nature Conservation-Bulgaria*, *18*, 61-78. https://doi.org/10.3897/natureconservation.18.13429

Ucar, F. M., & Sungur, S. (2017). The role of perceived classroom goal structures, self-efficacy, and engagement in student science achievement. *Research in Science & Technological Education*, *35*(2), 149-168. https://doi.org/10.1080/02635143.2017.1278684

Uitto, A. (2014). Interest, attitudes and self-efficacy beliefs explaining upper-secondary school students' orientation towards biology-related careers. *International Journal of Science and Mathematics Education*, *12*(6), 1425-1444. https://doi.org/10.1007/s10763-014-9516-2

van der Velde, T., Milton, D. A., Lawson, T., Wilcox, C., Lansdell, M., Davis, G., Perkins, G., & Hardesty, B. D. (2017). Comparison of marine debris data collected by researchers and citizen scientists: Is citizen science data worth the effort? *Biological Conservation*, *208*, 127-138.

Weintraub, A. S., Geithner, E. M., Stroustrup, A., & Waldman, E. D. (2016). Compassion fatigue, burnout and compassion satisfaction in neonatologists in the US. *Journal of Perinatology, 36*(11), 1021-1026. https://doi.org/10.1038/jp.2016.121

Wilson, A. (2012). Improving life satisfaction for the elderly living independently in the community: Care recipients' perspective of volunteers. *Social Work in Health Care*, *51*(2), 125-139. https://doi.org/10.1080/00981389.2011.602579

Wright, D. R., Underhill, L. G., Keene, M., & Knight, A. T. (2015). Understanding the motivations and satisfactions of volunteers to improve the effectiveness of citizen science programs. *Society & Natural Resources*, *28*(9), 1013-1029. https://doi.org/10.1080/08941920.2015.1054976

Zee, M., & Koomen, H. M. (2016). Teacher self-efficacy and its effects on classroom processes, student academic adjustment, and teacher well-being: A synthesis of 40 years of research. *Review of Educational Research*, *86*(4), 981-1015. https://doi.org/10.3102%2F0034654315626801

Zeldin, A. L., Britner, S. L., & Pajares, F. (2008). A comparative research of the self-efficacy beliefs of successful men and women in mathematics, science, and technology careers. *Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching*, *45*(9), 1036-1058.

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