Measuring Motivation to Participate in Online Citizen Science

We have developed an instrument to measure volunteer motivation to participate in online citizen science. We hope that this instrument, which we developed for use with volunteers of the citizen science projects at www.zooniverse.org, will serve as a resource for other citizen science researchers to examine the motivations of their volunteers. We first provide our instrument, adapted slightly from our original version to be applicable to other online citizen science projects. After summarizing our research program (page 8 of this document), we outline the theoretical model of motivation from which we developed our instrument (page 9), then describe our process of instrument creation (page 13). Lastly, we provide acknowledgements (page 21) and references (page 22). Preliminary results derived from this instrument are given in Reed, Raddick, Lardner, & Carney (2013).

Instrument

1. The project is not very visible online.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

2. It was easy for me to find the project website.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

3. People like me are generally aware of the project.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

4. I have seen or heard of other people using the project.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

5. I am aware that people using the project can interact with each other.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

6. The project's needs are clearly stated.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

7. I don't know what the project needs from me.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

8. In my opinion, the project has a need for help from people like me.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

9. When I first saw the project website, I thought it was attractive.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

10. When I first saw the project website, I thought that I liked the graphics and images used.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

11. When I first saw the project website, I thought that the screen layout was attractive.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

12. When I first saw the data of the project, I thought the data were attractive.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

13. I find the project to be easy to use.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

14. I find it easy to get the project to do what I want it to.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

15. My interaction with the project is clear and understandable.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

16. It was easy for me to become skillful at using the project.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

17. Interacting with the project does not require a lot of my mental effort.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

18. I was so involved with the project that I lost track of time.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

19. I was absorbed in my tasks on the project.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

20. I'm confident that I can understand the basic scientific concepts behind the project.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

21. I'm confident that I can understand the most complex scientific concepts behind the project.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

22. I am sure about my knowledge when it comes to contributing to the project.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

23. I feel confident that I can use the available technology to get things done in the project.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

24. I feel confident that I can contribute my thoughts to the project.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

25. I feel confident that I can log on and navigate the project web site.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

26. I know what other users expect from me as a forum contributor.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

27. I know the values of other project users.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

28. Volunteering makes me feel important.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

29. Volunteering makes me feel good about myself.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

30. I contribute to the project because I love to help others.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

31. I want to make the world a better place.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

32. I trust my fellow project volunteers.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

33. Other project volunteers can be respected as co-workers.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

34. I accept responsibility for my actions in the project.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

35. I fulfill the commitments I make to other volunteers in the project.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

36. Please choose the picture below which describes your perceived relationship with the project.
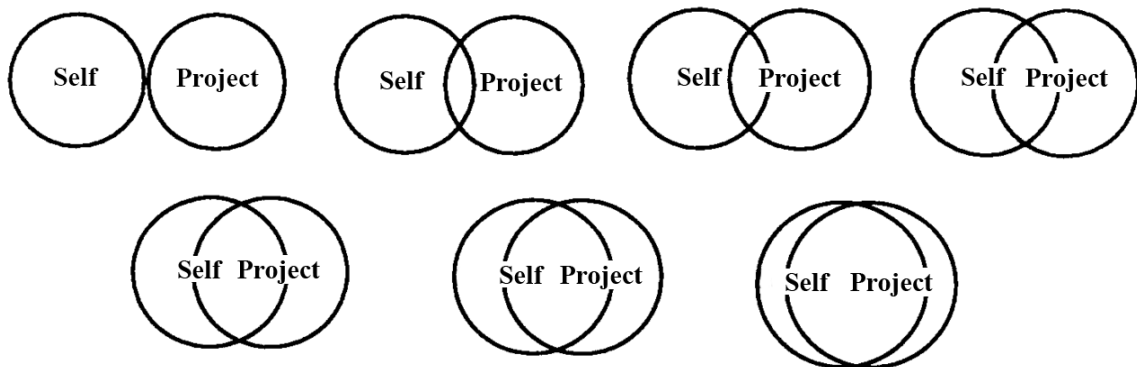
37. I have enough time to do what I would like to do on the project.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

38. It is difficult for me to find enough time in the day to go to the project website.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

39. Using the project was fun.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

40. The content of the project website incited my curiosity.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

41. I am interested in the subject matter of the project.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

42. I expect to benefit from the project professionally.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

43. I am interested in knowing my fellow project contributors.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

44. I enjoy getting to know my fellow project contributors.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

45. I feel it is important to help science.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

46. Helping science makes me feel good about myself.

Strongly	Disagree	Neither Agree	Agree	Strongly Agree

Disagree		Nor Disagree		

47. I can always find something that interests me on the project.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

48. I have a chance to do a number of different tasks in the project, using a wide variety of different skills and talents.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

49. I get to use a number of complex skills in the project.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

50. I expect my contribution to the project to provide clues about how well I am doing.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

51. My work in the project involves doing a number of different tasks.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

52. I do a complete task from start to finish in the project. The results of my efforts are clearly visible and identifiable.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

53. I enjoy being a part of the community of project volunteers.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

54. I am good at working with other project volunteers.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

Research Program Summary

One of the most important questions of citizen science is that of participant motivation: why do people choose to volunteer significant time and effort to participate online in a scientific research study?

Following up on our prior work with Galaxy Zoo (Raddick, et al. 2010, 2013), we created an instrument and implemented a survey of volunteers in twelve different projects of the Zooniverse.org citizen science portal, which together engaged hundreds of thousands of volunteers in one or more of 11 projects covering topics ranging from astronomy to climate science to archaeology. Preliminary results of the study have been published (Reed, Raddick, Lardner, & Carney, 2013), and full results will appear in a forthcoming publication.

We hope that other citizen science researchers can modify our instrument for use with their own projects, and the data collected can be a rich source of data for citizen science researchers for years to come.

Theoretical Model of Motivation

Our prior research with Galaxy Zoo (Raddick et al., 2010, 2013) does not generalize to other citizen science projects, and was also atheoretical – designed without reference to what other researchers have learned about citizen science motivation.

To develop a more complete picture of motivation across multiple citizen science projects, we conducted a review of the literature about motivation to participate in citizen science activities. We also reviewed literature in related areas, including motivations to participate in Wikipedia, motivations to volunteer offline (in real-world settings), and theories of work satisfaction from organizational psychology.

While our prior work considered all Galaxy Zoo users as a single population, this instrument is designed to consider the Zooniverse population as a mix of three overlapping behavior-based groups, adapted from Crowston & Fagnot (2008):

- **Initial** users have recently joined one of Zooniverse's component citizen science "zoos" (e.g. Galaxy Zoo, Old Weather), and have completed a few tasks in that zoo.
- **Sustained** users have demonstrated deeper engagement with Zooniverse, either by participating in a single project consistently over a longer time, or by contributing to multiple zoos.
- **Meta** users have transitioned to a different type of Zooniverse participation, one in which their primary focus in on the volunteer community and the operation of the site. These volunteers may or may not continue to perform citizen science tasks, but their efforts at community and site development take place primarily in parallel discussion spaces such as the Zooniverse forums and talk tools, email discussions, and in-person gatherings.

Having identified groups of volunteers, our next task was to identify likely motivations behind each group's participation in (one or more) Zooniverse projects. We

drew on a number of sources to create a model with five constructs, each of which includes multiple sub-constructs.

The constructs and sub-constructs are described below; they apply to all user types unless otherwise specified.

- Awareness: constructs related to the visibility of the project and its needs
    - Project visibility: volunteers have heard of the project
    - Visibility of project needs: volunteers are aware of the types of contributions that the project currently requires
    - Awareness of community: volunteers are aware that the project includes a community where other important activities take place
- Volunteer-website interaction: constructs related to the way in which volunteers experience the citizen science project website(s)
    - Aesthetic reaction: do volunteers find the project website sufficiently aesthetically pleasing to become and stay involved in the project?
    - Perceived ease of use: do volunteers find the site easy enough to use?
    - Focused attention: a measure of volunteers' ability and desire to concentrate mental activity on one stimulus – the citizen science task at hand – and ignore others (Matlin, 1994; O'Brien & Toms, 2008).
- Capacity: constructs related to volunteers' sense of whether or not they can perform the necessary tasks
    - Content self-efficacy: do volunteers believe that they know enough about the project's data source, scientific context, and required task(s) to engage in the citizen science activities?

- Media self-efficacy (O'Brien & Toms, 2008): do volunteers believe they have the technology skills required to engage with the citizen science project?

- Knowledge of community: do volunteers believe that they know enough about the volunteer community to participate?

- Obligation: constructs related to volunteers' sense of identification with the project and the sense that their contribution is necessary for the project to succeed

  - Identification with project: do volunteers see themselves as members of the citizen science project and its volunteer community?

  - Altruism: do volunteers hold a feeling of altruism toward the project?

  - Accountability to community: do volunteers see themselves as accountable to the project community – do they believe the community is relying on their contributions?

  - Trust in community: do volunteers believe that they can trust fellow members of the citizen science volunteer community?

- Evaluation: constructs that measure volunteers' evaluation of the costs and benefits of participating in the Zooniverse project

  - Available time: do volunteers believe they have enough free time available to devote to citizen science activities? Since Zooniverse is free and voluntary, the only major cost to participation for most users is time, and the associated opportunity cost.

- Curiousity: Do volunteers have enough curiosity about this potential new experience to be motivated to join the site?

- Interest in content: Are volunteers interested in the scientific content area of the Zoo?

- Identification with project goals: To what extent do volunteers share the values of the project and agree with its scientific goals?

- Felt Involvement: Do volunteers feel that the experience of the citizen science task was "fun" – did it draw them in to further involvement? This construct was defined by Kappelman (1995) and used in the survey instrument of O'Brien & Toms (2010).

- Social Interaction: What benefits do volunteers derive from interaction with the social community of the project?

- Intrinsic Motivation: To what extent do volunteers perceive as benefits the intrinsic motivation factors from organizational psychology identified by Hackman & Oldham (1980): skill variety, significance, identity, autonomy, and feedback?

Instrument Design

We created an instrument to measure the prevalence of each of the motivational constructs and sub-constructs described in the Motivational Model section above. We chose to solicit responses with a Likert Scale, with labels "Strongly Disagree," "Disagree," "Neither Agree Nor Disagree," "Agree," and "Strongly Agree." In our

analysis, we coded these text responses on a scale of 1 to 5, but these numerical values were not shown to participants.

As described above, we constructed an instrument designed to operationalize the constructs and sub-constructs given in our model. We chose to solicit responses to each item as a Likert Scale, with labels presented to the user as shown in **Error! Reference source not found.** (that is, the numerical values were not shown to the user, only the labels). Asking for the user's agreement with each item as a labeled Likert Scale value makes it straightforward for us to quantify the degree of agreement of each user in our analysis stage.

We chose items for inclusion based on a thorough literature review of the constructs and sub-constructs in our model. Table 1 shows the items we included. Whereas the item text the instrument given at the beginning of this paper has been generalized to be applicable to other citizen science projects, Table 1 lists the items exactly as they appeared on our instrument.

For each item in Table 1, we give the item an informal name which we used in our analysis of survey data. We then provide the text of the item as it appeared on the instrument, with "X Zoo" replaced by the name of the Zooniverse project the participant had used most often (e.g. Galaxy Zoo, Old Weather, Ancient Lives, etc.). To help ensure that our survey items did not become too predictable, we selected three items at random and changed them so that their scales would be reversed. The "rev?" column of Table 1 shows "yes" if the item has been reversed in this way. For these reversed-scale items, *lower* Likert Scale values represent higher values of the construct the item measures. In

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addition, for item "obligation9" we used the Inclusion of Other in Self scale item as is, on

a 1-7 scale, with the intention of rescaling the values prior to analysis.

The next two columns of Table 1 list the construct and sub-construct measured by

each item. Lastly, we provide the reference that was the source of the item. If a source

column lists a reference, it means we used the item from the reference, making only the

minimal changes necessary to place the item in the Zooniverse context. If the source

column says "adapted from," it means we made additional changes to the item to better

explain the construct in the context of Zooniverse. If the source column is blank, it means

we wrote the item text ourselves.

Item Name	Item Text	Item reversed?	Construct measured	Sub-construct measured	Source
awareness1	X Zoo is not very visible online	Yes	Awareness	Visibility of Project	
awareness2	It was easy for me to find the Zooniverse Web site.		Awareness	Visibility of Project	
awareness3	People like me are generally aware of X Zoo.		Awareness	Visibility of Project	Adapted from (Moore & Benbasat, 1991)
awareness4	I have seen or heard of other people using X Zoo		Awareness	Visibility of Project	Adapted from (Moore & Benbasat, 1991)
awareness5	I am aware that other people using X Zoo can interact with each other.		Awareness	Awareness of Community	
awareness6	X Zoo's needs are clearly stated		Awareness	Visibility of Project Needs	
awareness7	I don't know what X Zoo needs from me	Yes	Awareness	Visibility of Project Needs	

awareness8	In my opinion, X Zoo has a need for help from people like me		Awareness	Visibility of Project Needs	
vwi1	When I first saw the X Zoo website, I thought that the The X Zoo website was attractive		Volunteer-website Interaction	Aesthestic Reaction	(O'Brien & Toms, The Development and Evaluation of a Survey to Measure User Engagement, 2010)
vwi2	When I first saw the X Zoo website, I thought that I liked the graphics and images used on the X Zoo website.		Volunteer-website Interaction	Aesthestic Reaction	(O'Brien & Toms, The Development and Evaluation of a Survey to Measure User Engagement, 2010)
vwi3	When I first saw the X Zoo website, I thought that the screen layout of the X Zoo website visually pleasing.		Volunteer-website Interaction	Aesthestic Reaction	(O'Brien & Toms, The Development and Evaluation of a Survey to Measure User Engagement, 2010)
vwi4	When I first saw the data of X Zoo (e.g. galaxies, ship's logs, extrasolar planet light curves…), I thought that the data were attractive		Volunteer-website Interaction	Aesthestic Reaction	Adapted from (O'Brien & Toms, The Development and Evaluation of a Survey to Measure User Engagement, 2010)
vwi5	I find X Zoo to be easy to use		Volunteer-website Interaction	Perceived Ease of Use	Adapted from (O'Brien & Toms, The Development and Evaluation of a Survey to Measure User Engagement, 2010)

vwi6	I find it easy to get X Zoo to do what I want it to do		Volunteer-website Interaction	Perceived Ease of Use	(O'Brien & Toms, The Development and Evaluation of a Survey to Measure User Engagement, 2010)
vwi7	My interaction with X Zoo is clear and understandable		Volunteer-website Interaction	Perceived Ease of Use	(O'Brien & Toms, The Development and Evaluation of a Survey to Measure User Engagement, 2010)
vwi8	It was easy for me to become skillful at using X Zoo.		Volunteer-website Interaction	Perceived Ease of Use	(O'Brien & Toms, The Development and Evaluation of a Survey to Measure User Engagement, 2010)
vwi9	Interacting with X Zoo does not require a lot of my mental effort		Volunteer-website Interaction	Perceived Ease of Use	(O'Brien & Toms, The Development and Evaluation of a Survey to Measure User Engagement, 2010)
vwi10	I was so involved in X Zoo that I lost track of time		Volunteer-website Interaction	Focused Attention	(O'Brien & Toms, The Development and Evaluation of a Survey to Measure User Engagement, 2010)
vwi11	I was absorbed in my tasks on X Zoo		Volunteer-website Interaction	Focused Attention	(O'Brien & Toms, The Development and Evaluation of a Survey to Measure User Engagement, 2010)

capacity1	I'm confident that I can understand the basic scientific concepts behind X Zoo		Capacity	Content self-efficacy	
capacity2	I'm confident that I can understand the most complex scientific concepts behind X Zoo		Capacity	Content self-efficacy	
capacity3	I am sure about my knowledge when it comes to contributing to X Zoo		Capacity	Content self-efficacy	
capacity4	I feel confident that I can use the available technology to get things done in X Zoo.		Capacity	Media self-efficacy	Adapted from (Hsu & Chiu, 2004)
capacity5	I feel confident that I can contribute my thoughts to X Zoo.		Capacity	Media self-efficacy	
capacity6	I feel confident that I can log on and navigate on the X Zoo Web site.		Capacity	Media self-efficacy	Adapted from (Hsu & Chiu, 2004)
capacity7	I know what other X Zoo users expect of me as a forum contributor		Capacity	Knowledge of community	
capacity8	I know the values of other X Zoo users		Capacity	Knowledge of community	
obligation1	Volunteering makes me feel important		Obligation	Altruism	(Clary, et al., 1998)
obligation2	Volunteering makes me feel good about myself		Obligation	Altruism	(Clary, et al., 1998)

obligation3	I contribute to X Zoo because I love to help others		Obligation	Altruism	
obligation4	I want to make the world a better place		Obligation	Altruism	(Clary, et al., 1998)
obligation5	I trust my fellow X Zoo volunteers		Obligation	Trust in community	Adapted from (Xu & Jones, 2010)
obligation6	Other X Zoo volunteers can be respected as co-workers		Obligation	Trust in community	(Xu & Jones, 2010)
obligation7	I accept responsibility for my actions in X Zoo		Obligation	Accountability to community	(Wood & Winston, 2007)
obligation8	I fulfill the commitments I make to other volunteers in X Zoo		Obligation	Accountability to community	(Wood & Winston, 2007)
obligation9	Please choose the radio button next to the picture below which best describes your perceived relationship with Zooniverse?		Obligation	Accountability to community	(Aron, Aron, & Smollan, 1992)
evaluation1	I have enough time to do what I would like to do on X Zoo		Evaluation	Available Time	
evaluation2	It is difficult for me to find enough time in the day to go to the X Zoo website	Yes	Evaluation	Available Time	
evaluation3	Using X Zoo was fun.		Evaluation	Felt Involvement	
evaluation4	The content of the X Zoo website incited my curiosity		Evaluation	Curiosity	

evaluation5	I am interested in the subject matter of X Zoo (e.g. galaxies, the Moon, the climate, naval logs…)		Evaluation	Interest in Content	
evaluation6	I expect to benefit from X Zoo professionally		Evaluation	Extrinsic Motivation	
evaluation7	I am interested in knowing my fellow X Zoo contributors		Evaluation	Social Interaction	Adapted from (McAuley, Duncan, & Tammen, 1989)
evaluation8	I enjoy getting to know my fellow X Zoo contributors		Evaluation	Social Interaction	Adapted from (McAuley, Duncan, & Tammen, 1989)
evaluation9	I feel it is important to help science		Evaluation	Identifcation with Project Goals	Adapted from (Clary, et al., 1998)
evaluation10	Helping science makes me feel good about myself		Evaluation	Social Interaction	Adapted from (Clary, et al., 1998)
evaluation11	I can always find something that interests me on X Zoo		Evaluation	Interest in Content	
evaluation12	I have a chance to do a number of different tasks in X Zoo, using a wide variety of different skills and talents		Evaluation	Intrinsic Motivation	(Hackman & Oldham, 1980)
evaluation13	I get to use a number of complex skills in X Zoo		Evaluation	Intrinsic Motivation	(Hackman & Oldham, 1980)
evaluation14	I expect my contribution to X Zoo to provide clues about how well I am doing		Evaluation	Intrinsic Motivation	(Hackman & Oldham, 1980)

evaluation15	My work in X Zoo involves doing a number of different tasks.		Evaluation	Intrinsic Motivation	(Hackman & Oldham, 1980)
evaluation16	I do a complete task from start to finish in X Zoo. The results of my efforts are clearly visible and identifiable		Evaluation	Intrinsic Motivation	(Hackman & Oldham, 1980)
evaluation17	I enjoy being a part of the community of X Zoo volunteers		Evaluation	Belonging to Group	
evaluation18	I am good at working with other X Zoo volunteers		Evaluation	Belonging to Group	

Table 1. The items used in our instrument to measure the constructs and sub-constructs identified in our theoretical model of motivation. Each row in the table corresponds to one item. For each item, the table shows the variable name, the item text as it appeared on the survey instrument, whether or not the item scale is reversed (i.e. whether smaller response values correspond to higher levels of the sub-construct), the construct and sub-construct being measured, and the source of the item. See the text for an explanation of the Source column.

Items were presented to the user in random order, ten per page for five pages, with the last four items on the last page. We highly recommend that other citizen science projects that use our instrument should do the same.

Before presenting the Likert Scale items in Table 1, we asked a series of questions to solicit self-reports about volunteers' perceived behaviors in and attitudes toward Zooniverse. Another item asked for participants' most important reason for participating using the same forced-choice options as our prior study (Raddick, et al., 2013), allowing us to compare frequencies of motivations we had found then to frequencies of motivations in a new sample of Zooniverse volunteers. At the end of the instrument, we presented an additional page of demographic questions, asking for participant age,

gender, country of residence, highest level of education completed, ZIP code or postcode, and occupational category. These questions were also presented on a single page, in the same order for all participants.

The instrument was implemented as a web form on the zooniverse.org website. To ensure our sample selection and to minimize self-selection bias, the survey was invitation-only to volunteer email addresses selected from our database, stratified by the levels of participation defined in our model. Our incentive for volunteers to complete the survey instrument was a $10 electronic gift card to Amazon.com; we reasoned that since Zooniverse is an entirely online project, an online incentive would be appropriate.

References

Aron, A., Aron, E. N., & Smollan, D. (1992). Inclusion of other in the self scale and the structure of interpersonal closeness. Journal of personality and social psychology, 63(4), 596.

Clary, E. G., Snyder, M., Ridge, R. D., Copeland, J., Stukas, A. A., Haugen, J., & Miene, P. (1998). Understanding and assessing the motivations of volunteers: a functional approach. Journal of personality and social psychology, 74(6), 1516.

Crowston, K., & Fagnot, I. (2008, July). The motivational arc of massive virtual collaboration. In Proceedings of the IFIP WG 9.5 Working Conference on Virtuality and Society: Massive Virtual Communities (pp. 1-2).

Hackman, J. R., & Oldham, G. R. (1980). Work redesign.

Hsu, M. H., & Chiu, C. M. (2004). Internet self-efficacy and electronic service acceptance. Decision support systems, 38(3), 369-381.

Kappelman, L. A. (1995). Measuring user involvement: a diffusion of innovation perspective. ACM SIGMIS Database: the DATABASE for Advances in Information Systems, 26(2-3), 65-86.

Matlin, M. W. (1994). Cognition (4th edn).

McAuley, E., Duncan, T., & Tammen, V. V. (1989). Psychometric properties of the Intrinsic Motivation Inventory in a competitive sport setting: A confirmatory factor analysis. Research quarterly for exercise and sport, 60(1), 48-58.

Moore, G. C., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. Information systems research, 2(3), 192-222.

O'Brien, H. L., & Toms, E. G. (2008). What is user engagement? A conceptual framework for defining user engagement with technology. Journal of the American society for Information Science and Technology, 59(6), 938-955.

Raddick, M. J., Bracey, G., Gay, P. L., Lintott, C. J., Murray, P., Schawinski, K., Szalay, A. S., & Vandenberg, J. (2010). Galaxy Zoo: Exploring the motivations of citizen science volunteers. Astronomy Education Review, 010103.

Raddick, M. J., Bracey, G., Gay, P. L., Lintott, C. J., Cardamone, C., Murray, P., Schawinski, K., & Szalay, A. S. (2013). Galaxy Zoo: Motivations of citizen science volunteers. Astronomy Education Review, 12(1), 010106.

Reed, J., Raddick, M. J., Lardner, A., & Carney, K., (2013). An exploratory factor analysis of motivations for participating in Zooniverse, a collection of virtual citizen science projects. In 2013 46th Hawaii International Conference on System Sciences (pp. 610-619). IEEE.

Wood, J. A., & Winston, B. E. (2007). Development of three scales to measure leader accountability. Leadership & Organization Development Journal, 28(2), 167-185.

Xu, B., & Jones, D. R. (2010). Volunteers' participation in open source software development: a study from the social-relational perspective. ACM SIGMIS Database: the DATABASE for Advances in Information Systems, 41(3), 69-84.