Supplementary Information for

Bustling public communication by astronomers around the world driven by personal and contextual factors

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SUPPLEMENTARY TEXT

Profile of the respondents

78% of the respondents was male (n=1,971) and 22% female (n=558) (n=2,529); the average age was 54 years old (n=2,483, M=54, SD=12.5) with the majority holding senior positions: 12% were Chair/Director/Head, 36.4% were full professors, 20% were associate professors, 11% were assistant professors, 11% were at postdoctoral positions, and 9% were research fellows. Respondents were employed in 77 countries (n=2,584) and distributed by continents as follows: 47% in Europe, 27% in North America, 13% in Asia, 6% in South America, 5% in Australia and 2% in Africa. The vast majority worked for public research universities (52%) and government agencies (25%), and less than a quarter was distributed by NGOs/non-profit organizations (7%), private research universities (5%), other Universities or Colleges (4%) and private companies/industry (1%) (Mean frequency of researchers per research institute (M=63, SD=380.7; n=2,585). In terms of academic publications, the average publication per 5 years as reported by the community was M=24.4, Median=16, SD=38.9, n=2,467).

Binary Logistic Regressions

Model 1: motivations, seniority and research productivity

Model 1a (Table 6) and Model 1b (Table 7) consider the influence of motivations, seniority and research productivity. Model 1a (events) shows that intrinsic motivation (Wald=66.9, Exp(b)=2.82, $p<0.001$) and seniority (Wald=52.6, $p<0.001$) are significant determinants of high participation in events, and research productivity is not (Exp(b)=0.93, $p>0.05$). Model 1b (channels) shows that seniority is the most important factor for high participation in channels (Wald=97.6, $p<0.001$), followed by intrinsic

motivation and research productivity (Wald=47.5, Exp(b)=2.47, $p<0.001$). This shows that to be a high performer in news channels, research productivity is a determinant factor, while not important for high performance in public events. More academically productive astronomers (>=16 publications in the previous 5 years) are 2.5 times more likely to be high performers in media channels when compared with less academically productive researchers. Rewards were not statistically significantly; and extrinsic motivation 'role' was.

Model 2: gender and geographic region

When gender and geographic region are added to the regressions we find only differences with region. Both Model 2a (events) and Model 2b (channels) show that gender is not a determinant of high participation: both males and females were likely to be high performers. As for geographic regions, we found variations in astronomers' participation in public events in North America and in Africa. This effect is justified by the larger variance of the activity amongst astronomers working in Africa, and a more similar activity among astronomers working in North America. As for channels, Model 2b shows differences in the activity of Asian astronomers who are less likely to perform high in media channels (Exp (b)=0.66, $p<0.05$)).

Model 3: Institutional factors

In Model 3a and Model 3b all predictors are included. The three most important factors determining high participation by an astronomer in public communication activities are: intrinsic motivation, seniority and support from institutions. Funding, training and staffing, are significant determinants of participation, meaning that the likelihood of an astronomer to be a high performer is a function of the support received from their institutions: those with training in communication (compared to those who have not), funding available for communication (compared to those that have not) and those

collaborating with the communications staff at their institutions were more likely to perform high in astronomy communication. All VIF values were below 2.3, so collinearity did not influence the regression coefficients.

Table 1a. Number of scientists contacted and responses. Profile of respondents and tests of significance for gender, age and geographic region. Representativeness could not be calculated for seniority and academic productivity as no data were available for these in the sampling frame.

		Scientists contacted Sampling frame (N=9162)		Complete responses (N=2587)		X2 test
		N	%	N	%	
Gender (N=2530)	Male	7508	82	1972	77.9	X2=3.843; df=2; p=.146
	Female	1645	18	558	22.1	
	Total	9153	100	2530	100	
Age (N= 2482)	<=43	1781	19.4	573	23.1	X2=7.059; df=9; p=.631
	44-52	2024	23	615	24.8	
	53-62	2046	23.3	643	25.9	
	>=63	2930	33.4	652	26.3	
	Total	**8781**	**100**	**2483**	**100**	
Continent (N=2583)	Africa	152	1.7	54	2.1	X2=22.72; df=25; p=0.594
	Asia	1883	20.6	339	13.1	
	Europe	3948	43.1	1204	46.6	
	N. America	2478	27.1	707	27.4	
	Oceania	283	3.1	115	4.5	
	S. America	415	4.5	165	6.4	
	Total	9159	100	2584	100	
Seniority (N=2528)	Chair/Head/Dir			285	11.3	
	Professor			845	33.4	
	Assoc Prof			471	18.6	
	Assist Prof			254	10	
	Postdoc Fellow			257	10.2	
	Research Fellow			211	8.3	
	Other			205	8.1	
	Total			**2528**	**100**	
Publications (N=2465)	<=5			500	20.3	
	6-11			469	19	
	12-20			581	23.6	
	21-35			442	17.9	
	>=36			473	19.2	
	Total			**2465**	**100**	

Table 1b. Number of scientists contacted and responses per country (p>0.05). Only respondents with a valid email were included.

		Scientists contacted Sampling frame (N=9162)		Scientists responded Sample (N=2587)	
		N	%	N	%
Country	Algeria	1	0.0%	0	0.0%
	Andorra	1	0.0%	0	0.0%
	Angola	1	0.0%	0	0.0%
	Argentina	101	1.1%	33	1.3%
	Armenia	21	0.2%	7	0.3%
	Australia	254	2.8%	107	4.1%
	Austria	49	0.5%	18	0.7%
	Azerbaijan	4	0.0%	3	0.1%
	Belgium	113	1.2%	35	1.4%
	Brazil	167	1.8%	80	3.1%
	Bulgaria	54	0.6%	15	0.6%
	Canada	240	2.6%	72	2.8%
	Chile	97	1.1%	32	1.2%
	China	381	4.2%	53	2.1%
	Colombia	24	0.3%	10	0.4%
	Costa Rica	2	0.0%	1	0.0%
	Croatia	24	0.3%	7	0.3%
	Cuba	2	0.0%	1	0.0%
	Czech Republic	94	1.0%	30	1.2%
	Denmark	67	0.7%	24	0.9%
	Ecuador	1	0.0%	0	0.0%
	Egypt	37	0.4%	14	0.5%
	Estonia	20	0.2%	10	0.4%
	Ethiopia	3	0.0%	2	0.1%
	Finland	60	0.7%	20	0.8%
	France	600	6.5%	148	5.7%
	Georgia	4	0.0%	1	0.0%
	Germany	457	5.0%	135	5.2%
	Greece	85	0.9%	18	0.7%
	Honduras	1	0.0%	0	0.0%
	Hong Kong (S.A.R.)	0	0.0%	1	0.0%
	Hungary	64	0.7%	21	0.8%
	Iceland	5	0.1%	3	0.1%
	India	190	2.1%	44	1.7%
	Indonesia	11	0.1%	7	0.3%
	Iran, Islamic Republic of...	29	0.3%	5	0.2%
	Iraq	1	0.0%	0	0.0%
	Ireland	31	0.3%	7	0.3%
	Israel	71	0.8%	19	0.7%
	Italy	510	5.6%	179	6.9%
	Japan	582	6.4%	77	3.0%
	Kazakhstan	5	0.1%	3	0.1%
	Latvia	12	0.1%	1	0.0%
	Lebanon	3	0.0%	1	0.0%
	Lithuania	16	0.2%	4	0.2%
	Luxembourg	1	0.0%	0	0.0%
	Malaysia	5	0.1%	0	0.0%
	Mauritius	3	0.0%	2	0.1%
	Mexico	130	1.4%	50	1.9%
	Mongolia	4	0.0%	1	0.0%
	Morocco	5	0.1%	0	0.0%
	Namibia	0	0.0%	1	0.0%
	Netherlands	177	1.9%	53	2.1%
	New Zealand	29	0.3%	8	0.3%
	Nigeria	8	0.1%	1	0.0%
	Norway	30	0.3%	8	0.3%
	Oman	0	0.0%	1	0.0%
	Pakistan	2	0.0%	0	0.0%
	Panama	3	0.0%	0	0.0%
	Peru	3	0.0%	1	0.0%
	Philippines	5	0.1%	2	0.1%
	Poland	136	1.5%	19	0.7%
	Portugal	48	0.5%	24	0.9%
	Republic of Korea	138	1.5%	0	0.0%
	Romania	28	0.3%	10	0.4%
	Russian Federation	330	3.6%	75	2.9%
	Saudi Arabia	3	0.0%	0	0.0%
	Serbia	42	0.5%	18	0.7%
	Singapore	2	0.0%	1	0.0%
	Slovakia	40	0.4%	7	0.3%
	Slovenia	4	0.0%	4	0.2%
	South Africa	94	1.0%	34	1.3%
	South Korea	0	0.0%	15	0.6%
	Spain	306	3.3%	112	4.3%
	Sri Lanka	1	0.0%	0	0.0%
	Sweden	110	1.2%	34	1.3%
	Switzerland	88	1.0%	27	1.0%
	Taiwan	51	0.6%	11	0.4%
	Thailand	24	0.3%	8	0.3%
	Macedonia	2	0.0%	1	0.0%
	Trinidad and Tobago	1	0.0%	1	0.0%
	Turkey	48	0.5%	13	0.5%
	Ukraine	128	1.4%	31	1.2%
	United Arab Emirates	2	0.0%	0	0.0%
	United Kingdom	488	5.3%	155	6.0%
	United States	2101	22.9%	582	22.5%
	Uruguay	3	0.0%	2	0.1%
	Venezuela	16	0.2%	7	0.3%
	Viet Nam	11	0.1%	8	0.3%
	Tajakistan	6	0.1%	2	0.1%
	Vatican City	8	0.1%	2	0.1%
	Unknown	3		8	
Total		**9162**	**100.0%**	**2587**	**100.0%**

Table 2 and Table 3. Descriptive statistics for events and channels. We show the number (n) and percentage (%)of activities per geographic region, and the number of activities per astronomer per geographic region. In addition to the means, we present medians given the skewed data. Extreme cases were excluded.

Geographic region	EVENTS								
					n events per astronomer				
	n events	% events	n astronomers	% astronomers	*M*	*Lower Bound*	*Upper Bound*	*SD*	*Median*
Europe	10,961	47.6	1,047	47.1	10.5	9.6	11.4	14.8	6
North America	6,004	26.1	620	27.9	9.7	8.5	10.9	14.9	5
Asia	2,886	12.5	271	12.2	10.6	8.4	12.9	19.0	5
South America	1,669	7.2	139	6.3	12.0	9.0	15.1	18.1	6
Australia	1,004	4.4	104	4.7	9.7	7.5	11.8	11.2	6
Africa	522	2.3	43	1.9	12.1	8.7	15.6	11.3	10
Total	**23,046**	**100**	**2,224**	**100**	**10.4**	**8.6**	**12.9**	**15.4**	**5**

(Table 2)

Geographic region	CHANNELS								
					N channels per astronomer				
	n channels	% channels	n astronomers	% astronomers	*M*	*Lower Bound*	*Upper Bound*	*SD*	*Median*
Europe	8,611	48.4	1,027	47.1	8.4	7.7	9.1	11.9	4
North America	4,735	26.6	611	28.0	7.7	6.8	8.7	12.5	3
Asia	1,754	9.9	268	12.3	6.5	5.2	7.9	11.0	3
South America	1,278	7.2	134	6.1	9.5	7.2	11.8	13.4	5
Australia	979	5.5	102	4.7	9.6	7.1	12.1	12.9	5
Africa	423	2.4	40	1.8	10.6	5.6	15.6	15.6	7
Total	**17,780**	**100**	**2,182**	**100**	**8.1**	**6.6**	**10.9**	**12.2**	**4**

(Table 3)

Table 4. Percentage of communicators agreeing with each statement (n=2,226).

Item	Statement	% agreement
No enjoyment	"I do not enjoy it"	3%
No enthusiasm	"I am not enthusiastic"	6%
No skills	"I have no skills"	5%
No time	"I have no time"	22%
Not my responsibility (but communications staff)	"I see public communication as the responsibility of the communication staff of my host institution/research unit rather than my own"	16%
Negatively affect my career	"I think it will negatively affect my reputation as a researcher"	4%
Lack institutional support	"I lack institutional support (e.g. help from the communication staff, training, funding)"	26%
No impact on the public	"I do not think public communication initiatives will have an effect on the public (interest, enthusiasm, participation)"	3%
PE is a hobby rather than a duty	"I see public communication activities as a hobby rather than a duty"	20%
If it helped bring money in	"I would participate more of it helped bringing money to my host institution/research unit"	48%
If there were awards/prizes	"I would participate more if there were awards and prizes (recognition, money)"	27%
If it helped career progress	"I would participate more if it would help me to progress in my career"	43%

Table 5. Table 5 shows the structure of motive items and confirmatory factor analysis loadings for three dimensions. The latent variables are *intrinsic motivation* and *extrinsic motivation 'reward'* and *extrinsic motivation 'role'*. Each latent variable is measured with three or more observed variables. The factor loadings show that our hypothesized model fits well the observed data (n=2,226).

	Intrinsic Motivation	**Extrinsic Motivation 'Rewards'**	**Extrinsic Motivation 'Role'**
No enthusiasm	0.765		
No skills	0.640		
No time	0.562		
Not my responsibility	0.418		
No enjoyment	0.714		
If it helped career progress		0.858	
If there were awards/prizes		0.746	
If it helped bring money in		0.600	
See public communication as a hobby			0.494
Public communication will not impact public			0.646
Negatively affect my career			0.531
Lack institutional support			0.449

Table 6. Binomial logistic regression for events. In each model, we indicate the exponential of the coefficient (Exp(B)), associated confidence intervals and the Wald value for each predictor. The outcome variables are *intensity of participation* in events and channels. Reference categories are in brackets.

	Model 1			Model 2			Model 3		
	Exp(B)	**95% C.I.**	**Wald**	**Exp(B)**	**95% C.I.**	**Wald**	**Exp(B)**	**95% C.I.**	**Wald**
Intrinsic motivation (lo)	2.82***	[2.20, 3.62]	66.96	2.86***	[2.23, 3.67]	67.7	2.84***	[2.21, 3.66]	65.73
Extrinsic motivations 'rewards' (lo)	0.88	[0.69, 1.13]	1.00	0.87	[0.67, 1.12]	1.22	0.91	[0.70, 1.17]	0.55
Extrinsic motivation 'role' (lo)	1.43***	[1.17, 1.74]	12.79	1.42***	[1.17, 1.73]	12.42	1.37**	[1.12, 1.67]	9.63
Seniority (ref head)			52.62			52.66			46.02
Prof	0.44***	[0.33, 0.61]	26.11	0.45***	[0.33, 0.62]	24.71	0.48***	[0.35, 0.66]	20.88
Assoc Prof	0.48***	[0.34, 0.67]	17.98	0.46***	[0.32, 0.64]	20.04	0.48***	[0.34, 0.68]	16.87
Assist Prof	0.44***	[0.30, 0.65]	17.02	0.43***	[0.29, 0.64]	17.57	0.473***	[0.32, 0.70]	13.67
Postdoc	0.25***	[0.16, 0.38]	41.92	0.28***	[0.15, 0.36]	43.58	0.26***	[0.17, 0.40]	37.93
Research Fellow	0.30***	).192, 0.45]	31.43	0.30***	[0.20, 0.47]	29.27	0.32***	[0.21, 0.50]	25.94
Academic productivity (<=16 /5 yr)	0.93***	[0.77, 1.13]	0.53	0.92	[0.76, 1.12]	0.70	0.92	[0.75, 1.11]	0.77
Gender				0.98	[0.79, 1.26]	0.00	1.01	[0.80, 1.27]	0.00
Geographic region (ref Europe)						10.57			9.70
N.Amer				0.79*	[0.63, 1.00]	3.85	0.78*	[0.62, 0.99]	4.18
Asia				0.97	[0.72, 1.31]	0.05	1.00	[0.74, 1.36]	0.00
S.Amer				0.93	[0.63, 1.38]	0.13	0.98	[0.66, 1.45]	0.01
Oceania				1.19	[0.70, 2.01]	0.40	1.06	[0.62, 1.81]	0.05
Africa				2.29*	[1.11, 4.72]	4.99	2.13*	[1.03, 4.04]	4.16
Training (no)							1.51***	[1.23. 1.86]	14.83
Funding (no)							1.36***	[1.12, 1.66]	9.75
Staff_collab (no)							1.03***	[0.84, 1.25]	0.06
(Intercept)	1.124		0.388	1.198		0.822	0.83		0.73
Nagelkerke R^2		0.14			0.14			0.16	

* <0.05; ** <0.01; ***<0.001

Table 7. Binomial logistic regression for channels. In each model, we indicate the exponential of the coefficient (Exp(B)), associated confidence intervals and the Wald value for each predictor. The outcome variable is *high participation* in channels. Reference categories are in brackets.

	Model 1			Model 2			Model 3		
	Exp(B)	**95% C.I.**	**Wald**	**Exp(B)**	**95% C.I.**	**Wald**	**Exp(B)**	**95% C.I.**	**Wald**
Intrinsic motivation (lo)	2.47***	[1.91, 3.19]	47.46	2.44***	[1.89, 3.17]	45.83	2.48***	[1.91 3.23]	45.714
Extrinsic motivations 'rewards' (lo)	1.11	[0.85, 1.43]	0.58	1.12	[0.89, 1.45]	0.76	1.24	[0.95, 1.62]	2.596
Extrinsic motivation 'role' (lo)	1.34**	[1.10, 1.64]	8.60	1.35**	[1.11, 1.65]	8.75	1.29*	[1.05, 1.58]	5.97
Seniority (ref head)			97.60			101.59			90.485
Prof	0.39***	[0.28, 0.53]	34.22	0.391***	[0.28, 0.54]	33.16	0.42***	[0.30, 0.58]	28.143
Assoc Prof	0.29***	[0.21, 0.41]	48.00	0.27***	[0.19, 0.38]	53.01	0.28***	[0.20, 0.40]	47.766
Assist Prof	0.19***	[0.13, 0.29]	63.37	0.19***	[0.12, 0.28]	64.58	0.20***	[0.13, 0.31]	56.33
Postdoc	0.17***	[0.11, 0.26]	65.02	0.16***	[0.10, 0.24]	68.23	0.17***	[0.11, 0.27]	60.151
Research Fellow	0.23***	[0.15, 0.35]	44.24	0.22***	[0.14, 0.35]	44.03	0.24***	[0.15, 0.37]	38.809
Academic productivity (<=16 /5 yr)	1.42***	[1.17, 1.71]	12.92	1.37**	[1.12, 1.67]	10.02	1.35**	[1.11, 1.64]	8.659
Gender				0.98	[0.78, 1.24]	0.03	1.00	[0.79, 1.27]	0
Geographic region (ref Europe)						16.72			13.054
N.Amer				0.83	[0.66, 1.05]	2.39	0.83	[0.65, 1.06]	2.301
Asia				0.66**	[0.48, 0.90]	6.80	0.71	[0.51, 0.97]	4.608
S.Amer				1.21	[0.81, 1.82]	0.91	1.28	[0.85, 1.92]	1.366
Oceania				1.19	[0.78, 2.25]	1.07	1.18	[0.68, 2.03]	0.331
Africa				2.07*	[1.01, 4.23]	4.00	1.90*	[0.92, 3.92]	3.043
Training (no)							1.55***	[1.25. 1.92]	16.125
Funding (no)							1.53***	[1.25, 1.86]	17.421
Staff_collab (no)							1.51***	[1.24, 1.84]	16.489
(Intercept)	1.03		0.03	1.15		0.45	0.6		5.03
Nagelkerke R^2		0.14			0.15			0.19	

<0.05; ** <0.01; ***<0.001

Figure 1-9. Use of social media by astronomers (per year).