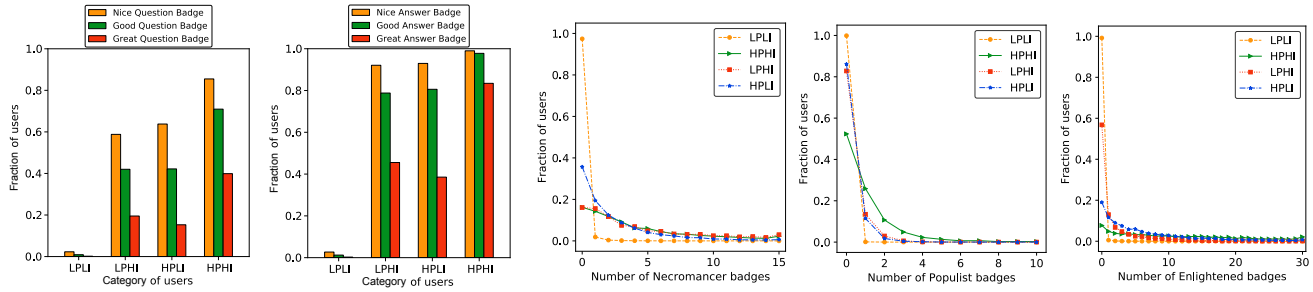

(a) **Fraction of users with badges for high scoring questions** (b) **Fraction of users with badges for high scoring answers** (c) **Distribution of number of Necromancer badges earned** (d) **Distribution of number of Populist badges earned** (e) **Distribution of number of Enlightened badges earned**

Figure 3: Relationship of LPLI, HPLI, LPHI and HPHI users to badges earned. Figures 3a and 3b study the presence of good quality question and answer badges among the different groups. Figures 3c, 3d and 3e depict the fraction of users in different communities that have earned multiple Necromancer, Populist and Enlightened badges.

low impact (HPLI), (c) low popularity, high impact (LPHI), (d) low popularity, low impact (LPLI). This segmentation is represented by the horizontal and vertical black lines in Figure 2. HPHI have mean popularity and impacts scores of 13,134 and 11,972,950 respectively, whereas LPLI have mean scores of 23 and 35,081 respectively. This shows the vast gulf between the two groups.

Figures 3a and 3b show the fraction of users belonging to each of the four categories HPHI, HPLI, LPHI and LPLI that have the particular badge. Interestingly, more LPHI, HPLI and HPHI users have badges for well-received answers (such as Nice Answer Badge) than they do for well-received questions (such as Nice Question Badge). Figures 3c, 3d and 3e display the distribution of the number of Necromancer, Populist and Enlightened badges earned by the four groups of users respectively. Consider the case of the Enlightened badge. We see that nearly 60% of LPHI users have zero Enlightened badges whereas only about 20% of HPLI users do not have that badge. We argue that there must be meaningful explanations that can be learned by comparing between these two groups.

Feature	HPLI	LPHI	t-statistic	Sig
Questions	54.65	42.02	-6.23	***
Answers	452.63	137.89	-39.97	***
Question Scores	233.15	286.61	4.38	**
Answer Scores	1190.07	679.83	-24.09	***
Reputation	16304.64	8672.31	-30.20	***
Necromancer Badges	2.47	6.32	29.6	***
Populist Badges	0.174	0.218	4.041	**
Great Answer Badges	0.682	0.887	7.84	***

Table 3: Differentiating between HPLI and LPHI users. ** = $p < 0.01$, *** = $p < 0.001$ represents statistical significance of Welch's t-statistic after Bonferroni correction ($p/14$).

We therefore examine HPLI and LPHI users and expect there to be differences in the way they contribute as well as reception to their contributions. Using Welch's t-test, we study the differences present between these two groups and present the features with the most significant differences between them in Table 3. We find that the number of questions and answers posted are significantly higher among HPLI, reflecting that they are more active. Conversely, the number of Necromancer, Populist and Great Answer Badges are higher for LPHI users. These badges appear to be signals that are costly to earn but not easily observable. Site design dictates that upvotes on answers return double the reputation points compared to upvotes on questions. Our findings show that LPHI users have a proportionally higher number of question and answer posts/scores. This implies that answers drive popularity, but it is questions that offer more influence. Further, some users link their SO accounts with other platforms such as LinkedIn, Github, etc. that may explain why they may be better known [1]. This is another potential source of divergence between high popularity and high impact.

7 CONCLUSION

The diverse range of actions and users, and massive quantity of content on Stack Overflow obfuscates the quality of information and efficiency of deliverables. It increases the transaction costs of participation. Game elements such as badges and reputation scores aim to provide incentives to balance these costs. But the design of these incentive structures has led to problems of adverse selection. In this paper, we present evidence that some of these game elements also act as reliable digital signals of social qualities such as popularity and impact. Our experiments reveal that certain non-trivial answer badges, high reputation scores and age of the user on the site indicate significant correlations. We also find differentiating characteristics that distinguish communities of popular and impactful users. We believe these insights offer guidance on combating inefficiencies arising out of bias towards specific actions. Our results encourage further exploration of the role of game elements as symbols of social status in socio-technical systems.

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