Online Appendix

Threatened by AI: Analyzing Users' Responses to the Introduction of AI in a Crowd-sourcing Platform

Mikhail Lysyakov

3-314 Carol Simon Hall

Simon School of Business

University of Rochester

NY 14620

mlysyako@simon.rochester.edu

Siva Viswanathan

4313 Van Munching Hall

Robert H. Smith School of Business

University of Maryland, College Park

MD 20742

sviswan1@umd.edu

Appendix A: Comparison of Contests' Task Requirements Before and After the Launch of AI

Task Descriptions' Requirements Classification. First, to capture emotions/feel requirements, we use sentiment analysis. We use the VADER (Valence Aware Dictionary and sEntiment Reasoner) toolkit (Hutto and Gilbert 2014) in Python[1]. Hutto and Gilbert (2014) have shown that the VADER sentiment analysis is very accurate and outperforms human raters. We expect that contest descriptions with more requirements to convey brand emotions/feel will have a higher overall sentiment score as compared to contest descriptions with fewer such requirements. We confirm this method by comparing task descriptions and sentiment scores for a sample of manually classified 300 random contest descriptions. Specifically, the correlation between the automated VADER sentiment scores and the manual counts of requirements to convey brand emotions/feel in task descriptions is 0.81.

To capture abstract or specific (concrete) requirements, we use the largest available dataset of 10,000 abstract/concrete terms (Pexman et al. 2017). Concrete and abstract words in the dataset are nouns, verbs, adjectives, and adverbs. For instance, such words as "bottle, mug, spade" are concrete, while such words as "excitement, happiness, truth, trust, hope" are abstract. We count the number of abstract and concrete (specific) terms and use those word counts as proxies of abstract and specific requirements in each contest task description. Again, we confirm this method by comparing task descriptions and the count of abstract and specific terms for a sample of manually classified 300 random descriptions. Specifically, the correlation between the automated count of abstract words and the manual count is 0.87, and the correlation between the automated count of specific words and the manual count is 0.89.

Comparison of Tasks before and after the AI System Launch. Next, we compare task descriptions of lower-tier and higher-tier logo contests before and after the AI launch to see if distributions of categories in task requirements change after the AI launch. Table A1 shows the comparison of lower-tier and higher-tier logo

[1] https://github.com/cjhutto/vaderSentiment

contest task descriptions on the dimensions of "abstract", "specific" task requirements and requirements to convey "brand emotions/feel".

Table A1. Comparison of lower-tier and higher-tier logo contest task descriptions before and after the launch of AI

Type of a contest	Abstract req. before AI	Abstract req. after AI	Specific req. before AI	Specific req. after AI	Emotions/feel req before AI	Emotions/feel req. after AI
Lower-tier logo contests	6.5	7.07	7.85	7.67	0.659	0.692
Higher-tier logo contests	8.9	9.02	9.39	9.5	0.722	0.725

Table A1 shows that higher-tier logo contests have more abstract requirements (36.9% more before AI and 27.6% more after AI) and more requirements to convey brand emotions/feel (9.56% more before AI and 6.3% more after AI) as compared to lower-tier logo contests. Also, the average number of abstract requirements per lower-tier contest increases from 6.5 to 7.07 after the AI launch, a 9% increase. This suggests that contests with fewer abstract requirements are more likely to be "cannibalized" by the AI system. The results in Table A1 are confirmed in regression analyses (see Table A2).

The number of "brand emotions/feel" requirements (sentiment score) per lower-tier contest increases from 0.659 to 0.692 (5% increase). Overall, since the number of lower-tier logo contests reduces by 25% after the AI launch and since the "cannibalized" contests have fewer abstract requirements and fewer requirements to convey brand emotions/feel as compared to the remaining contests (lower- and higher-tier contests), any designer has to choose among more-complex contests to participate in after the AI launch.

Table A2. Comparison of lower-tier and higher-tier logo contest task descriptions before and after the launch of AI

Indep. var.	Abstract requirements (lower-tier logo contests)	Specific requirements (lower-tier logo contests)	Brand emotions/feel requirements (sentiment, lower-tier logo contests)	Abstract requirements (higher-tier logo contests)	Specific requirements (higher-tier logo contests)	Brand emotions/feel requirements (sentiment, higher-tier logo contests)
After AI	0.099^{*} (0.06)	-0.042^{ns} (0.0513)	0.093^{*} (0.0546)	0.168^{ns} (0.12)	0.025^{ns} (0.064)	0.199^{ns} (0.136)
Constant	2.117^{***} (0.037)	1.44^{***} (0.031)	2.468^{***} (0.033)	2.492^{***} (0.047)	1.794^{***} (0.04)	3.292 (0.062)
Sample size	2,553	2,553	2,553	2,033	2,033	2,033

Appendix B: Descriptive Statistics and Comparison of AI Logo Design Emotions and Complexity with Human Logo Design Emotions and Complexity

Emotions' Classification Accuracy. Table B1 shows descriptive statistics for emotions and complexity variables.

Table B1. Descriptive statistics for the variables related to emotions and complexity

Name	**Description**	**Mean**	**St. Dev.**	**Min**	**Max**
Complexity	A spatial information complexity measure for each design image	0.887	0.741	0.1	2.975
Emotions_binary	A dummy variable indicating whether a design image has emotional content (1 – has, 0 - does not have)	268,049 designs classified as 1 157,426, designs classified as 0	NA	0	1
Amusement	One of the 5 emotions predicted in a design image by a deep learning model	1.35	1.65	0.01	53.7
Awe	One of the 5 emotions predicted in a design image by a deep learning model	0.319	0.99	0.003	75.69
Contentment	One of the 5 emotions predicted in a design image by a deep learning model	1.75	1.91	0.01	55.7
Excitement	One of the 5 emotions predicted in a design image by a deep learning model	3.63	3.38	0.04	59.2
Sadness	One of the 5 emotions predicted in a design image by a deep learning model	3.6	3.71	0.009	69.2

Table B2 shows the confusion matrix (the trade-off between true positive rates, true negative rates, false positive rates, and false negative rates) for the model with 5 emotions with the total accuracy of 72.14%.

It is pertinent to note that in the prior task of labeling design images by human raters (for presence or absence of emotions), agreement among human raters was close to 80%. Thus, the accuracy of 72.14% is comparable to human raters' accuracy. Additionally, if the model predicts low probability for each of the 5 emotions, we assign it to the category "other/neutral" and control for this category in econometric analyses.

Table B2. Confusion matrix for 5 emotions

Predicted Emotion / Real Emotion	Amusement	Awe	Contentment	Excitement	Sadness	Row Accuracy (%)
Amusement	**65**	14	8	45	7	46.7
Awe	2	**185**	4	2	3	94.4
Contentment	2	15	**148**	12	21	74.7
Excitement	29	10	17	**143**	19	65.6
Sadness	3	5	41	12	**161**	72.5
Column accuracy (%)	64.3	80.79	67.8	66.8	76.3	

Note. The results are shown for the 20% test set (973 images out of 4,865)

Emotions and Complexity of Designers' Submissions. Tables B3 and B4 show the complexity and emotions of designers' submissions before the AI launch.

Table B3. Complexity and emotions of the main three groups of designers before the AI launch

Independent Variables	Lower-tier designers	Cross-tier designers	Cross-category designers
Complexity	0.87	0.93	1.03
Emotions binary	0.75	0.79	0.84
Excitement	3.6	3.7	3.91

Note. We show the results only for excitement since this emotion is the most important for winning contests and for the successful designers (see Table 10 in the main paper and Table D2 in the Online Appendix D). The scores for emotions binary are calculated as proportions of logos with emotions out of the total number of logos.

Table B4. Complexity and emotions of the successful and unsuccessful designers before the AI launch

Independent Variables	Lower-tier designers who left the platform	Lower-tier designers unsuccess.	Cross-tier designers unsuccess.	Cross-category designers unsuccess.	Lower-tier designers success.	Cross-tier designers success.	Cross-category designers success.
Complexity	0.75	0.83	0.9	0.99	1.01	1.11	1.22
Emotions binary	0.69	0.73	0.77	0.81	0.8	0.837	0.885
Excitement	3.42	3.55	3.65	3.81	3.69	3.87	4.21

Note. We show the results only for excitement since this emotion is the most important for winning contests and for the successful designers (see Table 10 in the main paper and Table D2 in the Online Appendix D). The scores for emotions binary are calculated as proportions of logos with emotions out of the total number of logos.

Relationship between Emotions and Complexity. Prior research has found that there is positive correlation between logo image emotions and logo image complexity (De Marchis et al. 2018). We confirm that positive correlation in our setting. We find that the correlation between a binary variable for presence/absence of emotions and complexity (split by a median split into a binary variable with values 0 and 1) is 0.32 for both higher-tier and lower-tier logo contests and 0.2762 for non-logo contests, which is between the reported values in the prior study (De Marchis et al. 2018) that range from 0.16 (for objective non-human-rated measures of complexity and subjective measures of emotions) to 0.54 (for subjective human-rated measures of complexity and subjective measures of emotions).

Comparison of Human Logo Designs with the AI System Logo Designs. To understand the capabilities of the AI system with respect to design emotional content and complexity, we use the AI system to generate 1,078 different logos and measure emotional content and complexity of each AI-generated logo. With respect to emotions, we predict 5 emotions in AI-logo images and compare those with the predicted 5 emotions in human-generated logos. Interestingly, among human logos there are more logos (higher proportion, i.e., 60.2% vs 43%) with positive emotions, fewer logos with neutral emotions, and human logos have higher amusement and excitement emotion scores (higher by 36% for excitement and by 53% for amusement in absolute scores), but a lower contentment score (lower by 41.4%) as compared to the AI-logos. Interestingly, we find that the AI system can generate logos with complexity ranging from 0.1 to 1.14, while humans can generate logos with complexity ranging from 0.1 to 2.975. In our dataset 54.16% of designers produce at least one logo that is more complex than the AI maximum level of 1.14, while, overall, 27.8% of all human logo submissions have complexity higher the AI maximum level of 1.14.

Appendix C: Effects of Competition and Task Requirements on Emotions and Complexity

Table C1. Effects of competition on emotional content and complexity

Dependent Variable / Indep. Variable	Emotions_ binary (before AI)	Complexity (before AI)	Excitement (before AI)	Emotions_ binary (after AI)	Complexity (after AI)	Excitement (after AI)
Number of submissions per contest	-0.00067^{ns} (0.00057)	-0.0000165^{ns} (0.0000105)	-0.000556^{ns} (0.00057)	-0.00043^{ns} (0.000379)	-0.000077^{ns} (0.000071)	-0.00041^{ns} (0.00038))
Number of designers per contest	-0.0064^{ns} (0.0051)	-0.0011^{ns} (0.00105)	-0.000646^{ns} (0.00047)	-0.0062^{ns} (0.00453)	-0.00145^{ns} (0.0052)	-0.00165^{ns} (0.0028)
Number of contests available per day	0.0006^{ns} (0.00086)	-0.000039^{ns} (0.000216)	-0.00133^{ns} (0.00115)	0.00323^{ns} (0.0042)	0.00124^{ns} (0.0029)	0.00063^{ns} (0.0016)
Constant	1.526*** (0.02)	0.909*** (0.0019)	3.68*** (0.01)	1.657*** (0.02)	0.88*** (0.00178)	3.725*** (0.0098)
Designer Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Sample Size	206,867	206,867	206,867	191,394	191,394	191,394

Note. *** - p-value<0.01; ** - p-value<0.05; * - p-value<0.1; ns – not significant.

Table C2. Effects of task requirements on emotional content and complexity

Dependent Variable / Indep. Variable	Emotions_ binary (before AI)	Complexity (before AI)	Excitement (before AI)	Emotions_ binary (after AI)	Complexity (after AI)	Excitement (after AI)
Specific requirements	-0.0012^{ns} (0.0011)	0.01*** (0.001)	0.017^{ns} (0.05)	-0.0036^{ns} (0.0068)	0.0041*** (0.001)	-0.0113^{ns} (0.057)
Abstract requirements	0.0005^{ns} (0.00055)	0.0084*** (0.00086)	0.027^{ns} (0.046)	-0.00173^{ns} (0.005)	0.003*** (0.00088)	-0.01^{ns} (0.048)
Requirements for emotions/feel	0.00163*** (0.0004)	0.0052*** (0.00065)	0.017*** (0.0034)	0.0006*** (0.00011)	0.00157** (0.00067)	0.03*** (0.0036)
Constant	0.767*** (0.015)	0.887*** (0.0024)	3.55*** (0.0128)	0.775*** (0.0014)	0.859*** (0.00255)	3.687*** (0.014)
Designer Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Sample Size	206,867	206,867	206,867	191,394	191,394	191,394

Note. *** - p-value<0.01; ** - p-value<0.05; * - p-value<0.1; ns – not significant.

Appendix D: Effects of Emotions and Complexity on the Probability of Winning a Contest

Given the importance of emotional content and design complexity for logo designs, we evaluate whether those variables have positive effects on the probability of winning a contest.

Table D1 shows that the effect of presence of emotional content on the probability of winning a contest is positive and significant for lower-tier logo contests, higher-tier logo contests and non-logo contests in both periods (before and after the AI launch).

Additionally, Table D1 shows that the effect of design complexity on the probability of winning is positive in all three groups of contests in both periods (before and after the AI launch).

Table D1. Effects of emotional content and complexity on the probability of winning a contest

Dependent variable is Winner dummy	Lower-tier logo contests before AI	Lower-tier logo contests after AI	Higher-tier logo contests before AI	Higher-tier logo contests after AI	Non-logo contests before AI	Non-logo contests after AI
Complexity	0.127*** (0.045)	0.25*** (0.054)	0.354*** (0.051)	0.307*** (0.055)	0.275** (0.134)	0.15* (0.077)
Emotions_binary	0.145* (0.087)	0.384*** (0.14)	0.27*** (0.09)	0.16* (0.09)	0.457** (0.22)	0.245* (0.15)
Sub_order	0.0017*** (0.00055)	0.0037*** (0.00058)	0.00192*** (0.0007)	0.00087^{ns} (0.00077)	-0.0025^{ns} (0.00322)	-0.00434^{ns} (0.0294)
Star	0.54*** (0.0147)	0.617*** (0.019)	0.47*** (0.018)	0.495*** (0.019)	0.43*** (0.045)	0.49*** (0.037)
Experience	0.00037*** (0.00012)	0.0006*** (0.00011)	0.00011^{ns} (0.00012)	0.00055^{ns} (0.00074)	-0.0003935^{ns} (0.00034)	0.00033^{ns} (0.00021)
Designer fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Sample size	82,306	62,345	51,887	44,096	4,200	3,618

Note. *** - p-value<0.01; ** - p-value<0.05; * - p-value<0.1; ns – not significant

Next, we use a more granular model for 5 emotions to see which specific emotions affect the probability of winning a contest. Since the deep learning predictive model estimates probability of each emotion for each design image, we assign an emotion label to an image by a "majority vote", i.e., by the highest probability for one of the 5 emotions. All design images that have low probability for each of the five emotions are excluded from the analysis since they either have no emotional content or might represent some other emotion beyond the five emotions of focus. As a robustness check, we also add this indicator variable for "other/neutral" content to the model and find the results to be consistent (see Table D2).

As seen from Table D2, excitement (as compared to the omitted sadness) positively affects the probability of winning in all cases except for higher-tier logo contests before the AI launch. Amusement (as compared to the omitted sadness) positively affects probability of winning in lower-tier logo contests before AI, and in higher-tier logo contests before and after the AI launch. Other emotions are not significantly different from sadness in their effect on the probability of winning a contest.

Table D2. Effect of 5 emotions (dummy variables) on the probability of winning

Dependent variable is Winner dummy	**Lower-tier logo contests before AI**	**Lower-tier logo contests after AI**	**Higher-tier logo contests before AI**	**Higher-tier logo contests after AI**	**Non-logo contests before AI**	**Non-logo contests after AI**
Amusement	0.312* (0.18)	0.316^{ns} (0.211)	0.196* (0.117)	0.632*** (0.196)	0.51^{ns} (0.5)	0.166^{ns} (0.51)
Awe	0.114^{ns} (0.358)	-0.337^{ns} (0.493)	-0.195^{ns} (0.256)	0.32^{ns} (0.39)	0.2^{ns} (1.1)	1.01^{ns} (0.7)
Contentment	0.187^{ns} (0.146)	0.115^{ns} (0.172)	-0.008^{ns} (0.099)	0.286^{ns} (0.177)	0.22^{ns} (0.53)	0.44^{ns} (0.48)
Excitement	0.284*** (0.086)	0.192* (0.1)	0.0292^{ns} (0.069)	0.342*** (0.1)	0.84*** (0.28)	0.491* (0.265)
Sub_order	0.0019** (0.00078)	0.0036*** (0.00077)	0.00134* (0.000685)	-0.00087^{ns} (0.001)	0.008^{ns} (0.0052)	0.011** (0.0053)
Star	0.572*** (0.02)	0.62*** (0.024)	0.47*** (0.0169)	0.464*** (0.024)	0.258*** (0.058)	0.375*** (0.059)
Experience	0.00053*** (0.0001)	0.0017^{ns} (0.0011)	0.001* (0.0006)	0.0011^{ns} (0.00097)	-0.0061^{ns} (0.006)	-0.00191^{ns} (0.003)
Designer fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Sample size	38,247	28,818	38,092	23,506	1,186	1,382

Note. *** - p-value<0.01; ** - p-value<0.05; * - p-value<0.1; ns – not significant. "Sadness" is omitted category. Other/neutral" emotions are excluded.

Appendix E: Matching of Variables by PSM and Tests of Parallel Trends

Table E1. Differences between treatment (after AI) and control periods (before AI) for propensity score matching of contests

Variable	**Mean (Original sample)**		**P-value**	**Mean (Matched sample)**		**P-value**
	Before AI (n=2,768)	**After AI (n=1,732)**		**Before AI (n=2,518)**	**After AI (n=1,559)**	
Number of designers per contest	37.241	51.204	0.000	42.427	41.289	0.245
Number of submissions per contest	84.13	123.01	0.000	96.874	93.185	0.134
Abstract requirements	2.3324	2.433	0.047	2.4131	2.4233	0.864
Specific requirements	1.6304	1.5924	0.377	1.6337	1.6145	0.703
Requirements for emotions/feel	3.1958	3.2691	0.278	3.2771	3.2566	0.798

Table E2. Differences between treatment and control groups for propensity score matching of designers in logo (treatment) and non-logo contests (control)

Variable	**Mean (Original sample)**		**P-value**	**Mean (Matched sample)**		**P-value**
	Control (n=5,348)	**Treatment (n=215,018)**		**Control (n=4,902)**	**Treatment (n=193,521)**	
Number of submissions per designer per contest	4.9342	3.8199	0.000	4.9342	4.934	0.998
Experience of each designer in each contest (in days)	332.8	375.33	0.000	332.8	332.75	0.991

Table E3. Test of parallel trends in difference-in-differences models for successful lower-tier designers vs. control group 1 and control group 2

Dependent Variable / Indep. Variable	Emotions_binary (control group 1)	Complexity (control group 1)	Excite. (control group 1)	Emotions_binary (control group 2)	Complexity (control group 2)	Excite. (control group 2)
Treatment_group*time$_{t-6}$	0.166^{ns} (0.48)	-0.09^{ns} (0.058)	0.495^{ns} (0.37)	-0.0043^{ns} (0.34)	0.11^{ns} (0.07)	2.13* (1.28)
Treatment_group*time$_{t-5}$	0.74^{ns} (0.507)	-0.044^{ns} (0.059)	0.187^{ns} (0.379)	-0.94* (0.56)	0.165* (0.097)	0.338^{ns} (0.9)
Treatment_group*time$_{t-4}$	0.62^{ns} (0.51)	0.144^{ns} (0.111)	0.843^{ns} (0.657)	-0.46^{ns} (0.35)	-0.02^{ns} (0.074)	0.736^{ns} (0.83)
Treatment_group*time$_{t-3}$	-0.72^{ns} (1.19)	0.173^{ns} (0.242)	0.69^{ns} (1.33)	0.45^{ns} (0.38)	-0.016^{ns} (0.061)	0.22^{ns} (0.55)
Treatment_group*time$_{t-2}$	-0.036^{ns} (0.63)	0.054^{ns} (0.069)	-0.425^{ns} (0.442)	-0.87^{ns} (0.58)	-0.026^{ns} (0.082)	0.38^{ns} (0.82)
Treatment_group*time$_{t-1}$	0.032^{ns} (0.6303)	0.12^{ns} (0.09)	-0.492^{ns} (0.455)	-0.77^{ns} (0.56)	-0.0028^{ns} (0.073)	0.37^{ns} (0.91)
Treatment_group*time$_{t}$	Omitted Baseline	Omitted Baseline	Omitted Baseline	Omitted Baseline	Omitted Baseline	Omitted Baseline
Constant	3.2*** (0.36)	1.79*** (0.069)	4.16*** (0.325)	1.95*** (0.134)	1.08*** (0.022)	4.79*** (0.24)
Monthly Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Designer Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Sample Size	17,823	17,123	17,823	22,019	21,800	22,019

Note. *** - p-value<0.01; ** - p-value<0.05; * - p-value<0.1; ns – not significant. Treatment_group is successful lower-tier designers.

Table E4. Test of parallel trends in difference-in-differences models for successful cross-tier designers vs. control group 1 and control group 2

Dependent Variable / Indep. Variable	Emotions_binary (control group 1)	Complexity (control group 1)	Excitement (control group 1)	Emotions_binary (control group 2)	Complexity (control group 2)	Excitement (control group 2)
Treatment_group*time$_{t-6}$	0.27^{ns} (0.455)	0.055^{ns} (0.07)	0.118^{ns} (0.365)	0.27* (0.15)	.0406687 .0397622	-0.35^{ns} (0.37)
Treatment_group*time$_{t-5}$	0.908^{ns} (0.707)	0.1^{ns} (0.075)	0.142^{ns} (0.393)	0.5^{ns} (0.342)	0.189* (0.112)	-0.074^{ns} (0.35)
Treatment_group*time$_{t-4}$	0.661^{ns} (0.497)	0.254^{ns} (0.173)	0.575^{ns} (0.458)	0.24^{ns} (0.173)	0.041^{ns} (0.036)	0.32^{ns} (0.333)
Treatment_group*time$_{t-3}$	0.302^{ns} (0.197)	-0.062^{ns} (0.052)	0.183^{ns} (0.27)	0.14^{ns} (0.113)	0.015^{ns} (0.025)	0.027^{ns} (0.21)
Treatment_group*time$_{t-2}$	-0.397^{ns} (0.609)	-0.24^{ns} (0.155)	-0.571^{ns} (0.455)	0.48^{ns} (0.34)	0.027^{ns} (0.038)	0.5^{ns} (0.336)
Treatment_group*time$_{t-1}$	-0.028^{ns} (0.61)	0.05^{ns} (0.088)	-0.322^{ns} (0.465)	0.19^{ns} (0.133)	0.099^{ns} (0.096)	0.05^{ns} (0.326)
Treatment_group*time$_{t}$	Omitted Baseline	Omitted Baseline	Omitted Baseline	Omitted Baseline	Omitted Baseline	Omitted Baseline

Constant	3.11*** (0.32)	1.74*** (0.045)	3.708*** (0.239)	1.46*** (0.064)	0.999*** (0.0078)	4.3*** (0.072)
Monthly Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Designer Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Sample Size	15,086	14,987	15,086	26,253	25,949	26,253

Note. *** - p-value<0.01; ** - p-value<0.05; * - p-value<0.1; ns – not significant. Treatment_group is successful cross-tier designers.

Table E5. Test of parallel trends in difference-in-differences models for successful cross-category designers vs. control group1 and control group 2

Dependent Variable / Indep. Variable	**Emotions _binary (control group 1)**	**Complexity (control group 1)**	**Excitement (control group 1)**	**Emotions _binary (control group 2)**	**Comple xity (control group 2)**	**Excitement (control group 2)**
Treatment_group*time$_{t-6}$	0.146^{ns} (0.453)	-0.0695^{ns} (0.0665)	-0.089^{ns} (0.324)	0.45^{ns} (0.373)	0.12^{ns} (0.093)	-1.18^{ns} (0.81)
Treatment_group*time$_{t-5}$	0.803^{ns} (0.647)	0.0381^{ns} (0.0724)	0.187^{ns} (0.353)	0.175^{ns} (0.156)	0.167^{ns} (0.11)	-0.119^{ns} (0.387)
Treatment_group*time$_{t-4}$	0.619^{ns} (0.496)	0.175^{ns} (0.117)	0.411^{ns} (0.410)	0.19^{ns} (0.155)	-0.09^{ns} (0.06)	0.057^{ns} (0.38)
Treatment_group*time$_{t-3}$	0.428^{ns} (0.978)	0.262^{ns} (0.273)	0.957^{ns} (1.65)	0.22^{ns} (0.17)	0.12^{ns} (0.1)	0.09^{*} (0.05)
Treatment_group*time$_{t-2}$	-0.141^{ns} (0.608)	-0.138^{ns} (0.93)	-0.514^{ns} (0.405)	0.29^{ns} (0.196)	0.0872^{ns} (0.062)	0.37^{ns} (0.39)
Treatment_group*time$_{t-1}$	0.0149^{ns} (0.609)	0.052^{ns} (0.085)	-0.379^{ns} (0.416)	-0.009^{ns} (0.153)	-0.048^{ns} (0.04)	0.285^{ns} (0.375)
Treatment_group*time$_{t}$	Omitted Baseline	Omitted Baseline	Omitted Baseline	Omitted Baseline	Omitted Baselin e	Omitted Baseline
Constant	3.117*** (0.323)	1.736*** (0.044)	3.708*** (0.214)	1.48*** 0.149	0.9*** (0.014)	4.37*** (0.13)
Monthly Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Designer Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Sample Size	12,055	11,961	12,055	27,434	26,345	27,434

Note. *** - p-value<0.01; ** - p-value<0.05; * - p-value<0.1; ns – not significant. Treatment_group is successful cross-category designers.

Appendix F: Changes in Participation Behaviors and Emotions/Complexity after the AI Launch (PSM-DID models)

Table F1. Comparison of the number of contests before and after the AI launch for 3 groups of successful and unsuccessful designers as compared to the control group (PSM-DID1 model)

Dep. Var. is the number of contests per user per day	Lower-tier successful designers	Cross-tier successful designers	Cross-category successful designers	Lower-tier unsuccessful designers	Cross-tier unsuccessful designers	Cross-category unsuccessful designers
After	-0.071^{ns} (0.21)	0.0158^{ns} (0.255)	-0.0037^{ns} (0.183)	0.07^{ns} (0.1)	-0.031^{ns} (0.119)	0.473^{ns} (0.333)
Treated_group	1.578*** (0.27)	2.82*** (0.185)	1.552*** (0.189)	3.64*** (0.123)	2.67*** (0.083)	3.2*** (0.165)
DID	-0.0858^{ns} (0.203)	0.4^{ns} (0.258)	0.142^{ns} (0.186)	0.329** (0.167)	0.222* (0.121)	0.4* (0.22)
Sample size	27,920	26,852	22,540	61,185	58,498	34,937

Note. *** - p-value<0.01; ** - p-value<0.05; * - p-value<0.1; ns – not significant

Table F2. Comparison of the number of contests before and after the AI launch for 3 groups of successful and unsuccessful designers as compared to the control group (PSM-DID2 model)

Dep. Var. is the number of contests per user per day	Lower-tier successful designers	Cross-tier successful designers	Cross-category successful designers	Lower-tier unsuccessful designers	Cross-tier unsuccessful designers	Cross-category unsuccessful designers
After	0.171*** (0.01)	-0.024*** (0.0051)	0.02*** (0.0041)	-0.102*** (0.011)	-0.383*** (0.012)	-0.37*** (0.0125)
Treated_group	-0.88*** (0.039)	-0.41*** (0.0138)	-0.706*** (0.0082)	1.479*** (0.015)	0.907*** (0.0168)	1.494*** (0.0191)
DID	0.043^{ns} (0.051)	0.063*** (0.0182)	-0.168*** (0.0123)	0.48*** (0.025)	0.196*** (0.0272)	0.7445*** (0.0292)
Cons	3.112*** (0.0075)	3.21*** (0.0065)	3.15*** (0.0072)	3.495 (0.007)	3.62*** (0.0073)	3.63*** (0.0075)
Sample size	15,036	14,468	14,602	31,888	18,405	18,033

Note. *** - p-value<0.01; ** - p-value<0.05; * - p-value<0.1; ns – not significant

Table F3. Comparison of the number of submissions before and after the AI launch for 3 groups of successful and unsuccessful designers as compared to the control group (PSM-DID1 model)

Dep. Var. is the number of submissions per user per contest	Lower-tier successful designers	Cross-tier successful designers	Cross-category successful designers	Lower-tier unsuccessful designers	Cross-tier unsuccessful designers	Cross-category unsuccessful designers
After	-1.52** (0.655)	-0.092^{ns} (2.65)	-0.092^{ns} (1.95)	-0.714*** (0.231)	-0. 75*** (0.112)	-0.0545^{ns} (0.087)
Treated_group	-2.05*** (0.753)	-3.01^{ns} (1.931)	-2.91** (1.419)	-1.58*** (0.159)	-4.59*** (1,26)	-0.398*** (0.063)
DID	1.121* (0.63)	3.7*** (1.19)	6.69*** (1.98)	0.3776^{ns} (0.237)	0.6^{ns} (0.437)	0.081^{ns} (0.0878)
Cons	4.93*** (0.55)	5.19*** (0.55)	4.8*** (0.49)	4.27*** (0.07)	4** (1.51)	4.38*** (0.77)
Sample size	11,210	10,087	8,930	58,995	52,074	18,544

Note. *** - p-value<0.01; ** - p-value<0.05; * - p-value<0.1; ns – not significant

Table F4. Comparison of the number of submissions before and after the AI launch for 3 groups of successful and unsuccessful designers as compared to the control group (PSM-DID2 model)

Dep. Var. is the number of submissions per user per contest	Lower-tier successful designers	Cross-tier successful designers	Cross-category successful designers	Lower-tier unsuccessful designers	Cross-tier unsuccessful designers	Cross-category unsuccessful designers
After	-0.057^{ns} (0.038)	0.04*** (0.013)	-.00026^{ns} (.029)	0.0565*** (0.0092)	-0.04*** (0.0064)	-0.127*** (0.011)
Treated_group	-0.571*** (0.064)	1.6*** (0.0386)	4.92*** (0.174)	1.036*** (0.012)	1.09*** (0.007)	0.874*** (0.015)
DID	0.703*** (0.087)	0.61*** (0.33)	0.785*** (0.22)	-0.214*** (0.0188)	0.104^{ns} (0.113)	0.305^{ns} (0.229)
Cons	4.64*** (0.013)	3.36*** (0.0096)	4.75*** (0.021)	2.875*** (0.0057)	2.63*** (0.0072)	2.63*** (0.007)
Sample size	22,331	16,037	17,411	34,978	17,148	18,461

Note. *** - p-value<0.01; ** - p-value<0.05; * - p-value<0.1; ns – not significant

Table F5. Number of successful and unsuccessful designers by group

Group	Winners before AI – winners after AI	Winners before AI – losers after AI	Losers before AI – winners after AI	Losers before AI – losers after AI
Number of designers	335	386	169	1,484

Table F6. Comparison of presence of emotions before and after the AI launch for groups of *unsuccessful* designers and *successful* designers

Dep. var. is complexity	Lower-tier (win–win)	Cross-tier (win–win)	Cross-cat. (win – win)	Lower -tier (win – lose)	Cross-tier (win – lose)	Cross-cat. (win – lose)	Lower -tier (lose – win)	Cross-tier (lose – win)	Cross-cat. (lose – win)	Lower -tier (lose – lose)	Cross-tier (lose – lose)	Cross-cat. (lose – lose)
After	0.075^{***} (0.018)	0.3^{***} (0.043)	0.17^{***} (0.023)	-0.07^{ns} (0.05)	0.025^{ns} (0.035)	-0.025^{ns} (0.053)	0.21^{***} (0.048)	0.15^{*} (0.032)	0.52^{***} (0.066)	0.033^{ns} (0.023)	-0.001^{ns} (0.054)	-0.1^{ns} (0.086)
Cons	1.39^{***} (0.068)	1.59^{***} (0.13)	1.53^{***} (0.086)	1.37^{***} (0.07)	1.57^{***} (0.07)	1.51^{***} (0.13)	1.25^{***} (0.12)	1.45^{***} (0.12)	1.23^{***} (0.13)	1.22^{***} (0.05)	1.18^{***} (0.074)	1.24^{***} (0.12)
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N. of designers	56	28	37	130	133	42	64	58	34	439	209	82
Sample size	17,732	12,347	9,457	15,211	15,334	12,205	13,624	10,932	7,977	17,921	12,347	9,993

Note. *** - p-value<0.01; ** - p-value<0.05; * - p-value<0.1; ns – not significant. "Win-win" means winning both before and after the AI introduction. "Win-lose" means winning before the AI introduction and losing after the AI introduction. "Lose-win" means losing before the AI introduction and winning after the AI introduction. "Lose-lose" means losing both before and after the AI introduction.

Table F7. Comparison of complexity before and after the AI launch for groups of *unsuccessful* designers and *successful* designers

Dep. var. is complexity	Lower-tier (win–win)	Cross-tier (win–win)	Cross-cat. (win – win)	Lower -tier (win – lose)	Cross-tier (win – lose)	Cross-cat. (win – lose)	Lower -tier (lose – win)	Cross-tier (lose – win)	Cross-cat. (lose – win)	Lower -tier (lose – lose)	Cross-tier (lose – lose)	Cross-cat. (lose – lose)
After	0.05^{***} (0.007)	0.1^{***} (0.01)	0.09^{***} (0.008)	-0.07^{ns} (0.05)	-0.04^{ns} (0.03)	-0.03^{ns} (0.019)	0.06^{***} (0.012)	0.08^{**} (0.015)	0.15^{***} (0.02)	-0.02^{ns} (0.014)	-0.03^{ns} (0.024)	0.02^{ns} (0.02)
Cons	0.9^{***} (0.005)	0.98^{***} (0.008)	0.99^{***} (0.004)	0.91^{***} (0.005)	0.97^{***} (0.004)	0.98^{***} (0.08)	0.89^{***} (0.009)	0.94^{***} (0.014)	0.89^{***} (0.015)	0.78^{***} (0.006)	0.76^{***} (0.006)	0.8^{***} (0.014)
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N. of designers	56	28	37	130	133	42	64	58	34	439	209	82
Sample size	17,611	12,122	9,296	15,007	15,273	11,994	13,145	10,775	7,849	17,791	12,151	9,861

Note. *** - p-value<0.01; ** - p-value<0.05; * - p-value<0.1; ns – not significant. '"Win-win" means winning both before and after the AI introduction. "Win-lose" means winning before the AI introduction and losing after the AI introduction. "Lose-win" means losing before the AI introduction and winning after the AI introduction. "Lose-lose" means losing both before and after the AI introduction.

Table F8. Comparison of presence of emotional content before and after the AI launch for 3 groups of *successful* designers as compared to the control group (PSM-DID1 model)

Dep. variable is emotions_binary	Lower-tier successful designers	Cross-tier successful designers	Cross-category successful designers
After	-0.18^{ns} (0.42)	-0.31^{ns} (0.37)	-0.36^{ns} (0.27)
Treated_group	-1.89*** (0.132)	-1.64*** (0.3)	-1.98*** (0. 2)
DID	0.261** (0.129)	0.43** (0.19)	0.478** (0.22)
Constant	2.75*** (0.27)	1.3*** (0.031)	0.955** (0.467)
Sample size	17,823	15,086	14,337

Note. *** - p-value<0.01; ** - p-value<0.05; * - p-value<0.1; ns – not significant

Table F9. Comparison of presence of emotional content before and after the AI launch for 3 groups of successful designers as compared to the control group (PSM-DID2 model)

Dep. variable is emotions_binary	Lower-tier successful designers	Cross-tier successful designers	Cross-category successful designers
After	-0.0687*** (0.011)	-0.0399*** (0.012)	0.0164^{ns} (0.0132)
Treated_group	-0.119*** (0.019)	0.0377^{ns} (0.038)	-0.022^{ns} (0.0237)
DID	0.149*** (0.0266)	0.153*** (0.0473)	0.146*** (0.033)
Constant	1.06*** (0.008)	0.998*** (0.0088)	0.984*** (0.0097)
Sample size	19,938	15,520	14,372

Note. *** - p-value<0.01; ** - p-value<0.05; * - p-value<0.1; ns – not significant

Table F10. Comparison of complexity before and after the AI launch for 3 groups of successful designers as compared to the control group (PSM-DID1 model)

Dependent variable is complexity	Lower-tier successful designers	Cross-tier successful designers	Cross-category successful designers
After	-0.054^{ns} (0.074)	-0.189*** (0.07)	-0.181** (0.072)
Treated_group	-0.958*** (0.086)	-0.85*** (0.1)	-0.925*** (0.113)
DID	0.068** (0.031)	0.197*** (0.068)	0.224*** (0.07)
Constant	1.72*** (0.047)	1.117*** (0.058)	1.779*** (0.101)
Sample size	17,123	14,987	14,149

Note. *** - p-value<0.01; ** - p-value<0.05; * - p-value<0.1; ns – not significant

Table F11. Comparison of complexity before and after the AI launch for 3 groups of successful designers as compared to the control group (PSM-DID2 model)

Dependent variable is complexity	Lower-tier successful designers	Cross-tier successful designers	Cross-category successful designers
After	-0.119*** (0.0036)	-0.048*** (0.0044)	-0.069*** (0.0043)
Treated_group	0.0669*** (0.0062)	0.51*** (0.032)	0.13** (0.0078)
DID	0.148*** (0.0086)	0.0652* (0.037)	0.121*** (0.01)
Constant	0.75*** (0.0025)	0.506*** (0.003)	0.685*** (0.0032)
Sample size	19,365	15,173	14,044

Note. *** - p-value<0.01; ** - p-value<0.05; * - p-value<0.1; ns – not significant

Table F12. Five emotions before and after the AI launch for 3 groups of *unsuccessful* designers

Dep. var. is one of the 5 emotions (Y_{dc})	Lower-tier	Cross-tier	Cross-cat.	Lower-tier (PSM – DID1)	Cross-tier (PSM – DID1)	Cross-cat. (PSM – DID1)	Lower-tier (PSM – DID2)	Cross-tier (PSM – DID2)	Cross-cat. (PSM – DID2)
$After_t$ or $After_t$*$Treatment_{cd}$ for DID (amus.)	-0.036^{ns} (0.028)	-0.053^{ns} (0.048)	-0.035^{ns} (0.029)	0.071^{ns} (0.09)	0.06^{ns} (0.067)	0.0277^{ns} (0.0474)	-0.036^{ns} (0.0298)	-0.021^{ns} (0.0174)	0.023^{ns} (0.018)
$After_t$ or $After_t$*$Treatment_{cd}$ for DID (awe)	0.016^{ns} (0.0103)	-0.0012^{ns} (0.0124)	-0.012^{ns} (0.015)	0.0062^{ns} (0.157)	-0.163^{ns} (0.137)	-0.0343^{ns} (0.0345)	0.027^{ns} (0.0195)	0.0004^{ns} (0.0109)	-0.015^{ns} (0.012)
$After_t$ or $After_t$*$Treatment_{cd}$ for DID (content.)	-0.026^{ns} (0.026)	-0.0087^{ns} (0.0335)	0.023^{ns} (0.035)	-0.06^{ns} (0.058)	-0.079^{ns} (0.0788)	-0.134^{ns} (0.256)	0.029^{ns} (0.024)	-0.02^{ns} (0.0194)	-0.0106^{ns} (0.014)
$After_t$ or $After_t$*$Treatment_{cd}$ for DID (excit.)	-0.074^{ns} (0.059)	-0.01^{ns} (0.062)	0.031^{ns} (0.063)	0.089^{ns} (0.74)	0.0699^{ns} (0.09)	0.08^{ns} (0.108)	-0.208^{ns} (0.25)	-0.12^{ns} (0.0909)	0.022^{ns} (0.0223)
$After_t$ or $After_t$*$Treatment_{cd}$ for DID (sadness)	-0.064^{ns} (0.045)	0.097^{ns} (0.068)	-0.09^{ns} (0.067)	0.223^{ns} (0.55)	0.31^{ns} (0.197)	0.622^{ns} (0.475)	-0.0733^{ns} (0.0459)	0.0255^{ns} (0.036)	-0.072^{ns} (0.037)
Fixed effects	Yes	Yes	Yes	No	No	No	No	No	No
N. of designers	604	462	319	NA	NA	NA	NA	NA	NA
Sample size	59,721	31,358	18,627	71,035	38,432	15,051	34,146	28,324	24,675

Note. *** - p-value<0.01; ** - p-value<0.05; * - p-value<0.1; ns – not significant; NA – not available. Subscript t denotes time, subscript d denotes designers, subscript c – contests, subscript cd – matched contests and designers in treatment and control groups, subscript dc – average emotion (one of the five emotions) for all submissions per designer per contest.

Table F13. Comparison of five emotions before and after the AI launch for 3 groups of successful designers as compared to the control group (PSM-DID1 model)

Dependent variable is After AI	**Lower-tier successful designers**	**Cross-tier successful designers**	**Cross-category successful designers**
Amusement (DID)	-0.07^{ns} (0.084)	0.064^{ns} (0.078)	0.293^{ns} (0.303)
Awe (DID)	0.0198^{ns} (0.054)	-0.144^{ns} (0.171)	0.051^{ns} (0.232)
Contentment (DID)	-0.2^{ns} (0.17)	0.06^{ns} (0.11)	0.079^{ns} (0.339)
Excitement (DID)	0.46* (0.25)	0.81** (0.41)	0.74** (0.36)
Sadness (DID)	0.255^{ns} (0.21)	-0.2^{ns} (0.218)	-0.386^{ns} (0.758)
Sample size	17,717	15,017	14,122

Note. *** - p-value<0.01; ** - p-value<0.05; * - p-value<0.1; ns – not significant. Only DID coefficients are reported.

Table F14. Comparison of five emotions before and after the AI launch for 3 groups of successful designers as compared to the control group (PSM-DID2 model)

Dependent variable is After AI	**Lower-tier successful designers**	**Cross-tier successful designers**	**Cross-category successful designers**
Amusement (DID)	-0.024^{ns} (0.0278)	-0.0185^{ns} (0.0468)	0.026^{ns} (0.0325)
Awe (DID)	-0.0018^{ns} (0.0183)	-0.143^{ns} (0.281)	-0.0425^{ns} (0.03)
Contentment (DID)	-0.11^{ns} (0.09)	-0.0528^{ns} (0.052)	-0.136^{ns} (0.137)
Excitement (DID)	0.44*** (0.0584)	0.299*** (0.0932)	0.358*** (0.0636)
Sadness (DID)	0.113^{ns} (0.0783)	0.226^{ns} (0.21)	0.348^{ns} (0.272)
Sample size	19,021	15,301	14,121

Note. *** - p-value<0.01; ** - p-value<0.05; * - p-value<0.1; ns – not significant. Only DID coefficients are reported.

Appendix G: Survey of Designers

Table G1. Content of the Amazon Mechanical Turk (MTurk) survey of designers

Instructions	In this survey, you will be asked to imagine a given hypothetical scenario. Based on this scenario, you will be asked to respond to several questions.
The hypothetical scenario	The hypothetical scenario: you participate in crowdsourcing contests and create logo designs and other types of designs (i.e., T-shirt design) for many clients on a platform X. The platform X connects designers and clients. At some point, the platform introduces an Artificial Intelligence system for logo design, and after the introduction of this system, clients can choose contests with human designers for their design tasks or choose the artificial intelligence system and purchase designs from that system.

	The examples of logos designed by the Artificial Intelligence system are the following: see Figure G1 below Please answer several questions below about your potential responses (reactions) to the artificial intelligence system.
Question 1	If you think of the use of AI in this specific context for logo design, on a scale from 1 (non-threatening) to 5 (very threatening), how threatening to your job as a designer do you think this artificial intelligence system for logo design is? (this question is based on the scale "Threats of Artificial Intelligence" by Kieslich et al. 2021)
Question 2	If you perceive the threat, how would you change your behavior in response to the threat of AI? Answer options: 1. *Not applicable (I do not feel the threat);* 2. *I will avoid competing with AI by leaving the platform;* 3. *I will improve my logo designs to make them better than the logo designs generated by AI.*
Question 3	Open-ended question: If you change your logo designs to make them better than the designs generated by AI, please explain how you would change logo designs and what specific design elements or design content/ meaning you would use to differentiate your logo designs from the AI.
Demographics questions	Level of expertise as designer, age, education, race, gender

Figure G1. Examples of AI-generated logo designs used in the survey

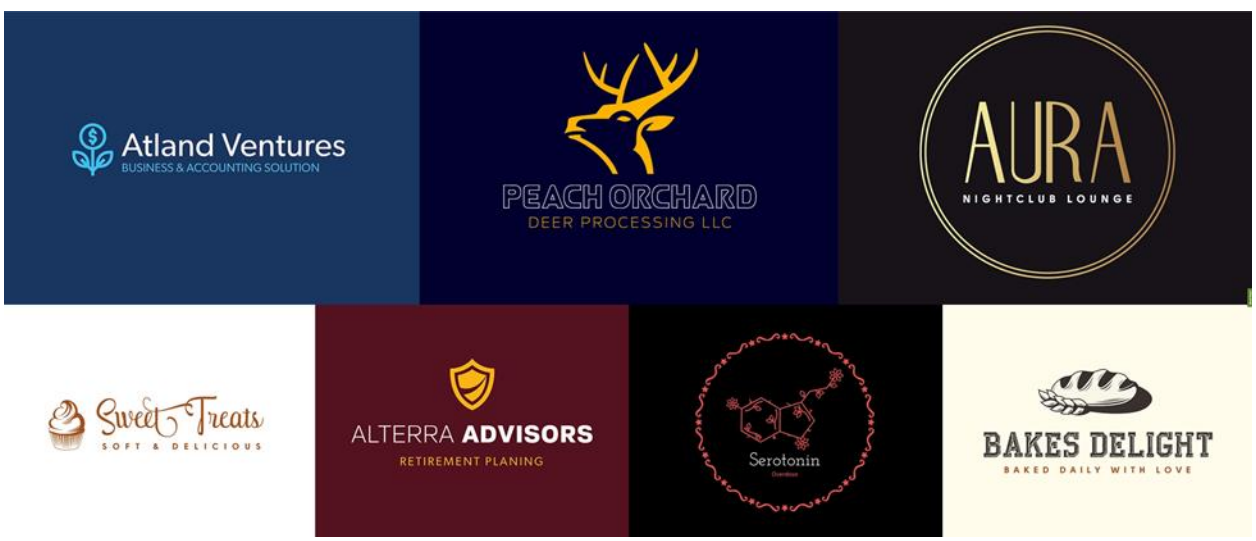

Table G2. Descriptive statistics for the survey of designers (96 respondents)

Variable	Threat of AI score (1-5)	Expertise level of 31 designers who say that they will avoid AI (1-beginner, 3-expert)	Expertise level of 53 designers who say that they will improve designs (1-beginner, 3-expert)
Mean	3.25	2.07	2.5
Std. Dev.	1.273	0.627	0.619

Table G3. Sample of designers' responses to an open-ended question about design improvements in response to AI

1	I would change the design style, making it more personalized, unique, with details that reflect the user's personality escaping the generic designs that AI's can do.
2	Would make my design more emotional, more appealing to human. I'll give my design human touch, which is difficult for AI.
3	I would have to evaluate the aspects that the AI is incapable of and focus there.
4	I would add more emotion to my work where the viewer could see and feel what I was trying to show something a computer cannot do. You can see and feel movement in brush strokes and drawing something a computer can't do.
5	I would try at add more unique elements rather than just create generic looking logos that all feel the same.
6	I would just try to make them more original and clever I guess. The AI is going to only use what was inputted into it, so maybe my world knowledge would be different?
7	I would give them a human touch that is more creative and less uniform.
8	Depending on what the client wants, I can give emphasis to the logo from a sentimental aspect, adding loads of happiness or sadness for example, which I don't think the AI can do.
9	I would go more abstract with the shapes of the logos.
10	I would look for clever meaning to infuse into the logo to convey meaning.

11	I would stay on top of current design trends and improve upon them in ways that are suitable for each client. I have the ability to look more deeply into the emotional content that a client may be looking for.
12	I would integrate a unique logo based on the client needs and not use stock images. I would employ creativity to capture the sentiment of the business.
13	I have to change designs to add very deep meaning and emotional content and also designs have to have good impression for the people.
14	I would try to incorporate something meaningful to humans, like an idea or feeling that the AI couldn't generate.
15	I feel like I would add components that AI might not grasp. Visual metaphors for instance, I feel like AI generated logos would be simplistic in general.
16	There are things that I can creatively do as a human being that AI is incapable of duplicating. AI is not to capture feeling or warmth when creating, and that is the strength I have as a human. I would never deliberately change my style. I would continue to be authentic and true to myself.
17	I think logo design is the elements plus emotional design.
18	The only hope I'd have for outcompeting the AI entity, would be to try to connect with the client in a more human/personal way than could an algorithm. Hopefully, that extra effort to tap into the emotional side of the client would pay dividends.
19	I would probably add some slight imperfections and asymmetries to the logos as this seems to give them a uniquely human touch.
20	I would do more edgy designs rather than the plain ones like the AI uses I would pick something with more design elements maybe some different colors and font.
21	I would add a more human touch. There are certain things AI doesn't understand creatively.
22	I would probably make them more complex. I would experiment more with colors and try more detailed designs, such as by adding more elements and making them more unique than the AI can produce. I would use different fonts and more detailed images, more intricate and complex banners.

23	I would make the logos a little more abstract and less generic, incorporating the words into the image rather than an image and then words below.
24	I would add more specific details & add a pitch line on the bottom or top.
25	I would make them more dynamic and create more unique display type fonts.

References for Appendices

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