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COVID-19 Alternative Sensory Testing of Liquid Foundation. Analyzing the Impact of Variable Evaluation Conditions at Home

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Abstract

Background:

During the COVID-19 pandemic, sensory panel testing in standardized booth conditions halted. To move projects along during this time, L'Oréal's descriptive sensory panel began testing at home. This was an interim option for the labs to continue understanding the performance of their products in an agile way.

Methods:

L'Oréal's descriptive sensory panel is trained following International Standard ISO 11132 (2012). To create an environment to test products at home, the sensory team developed methodologies to mimic onsite testing conditions. The panelists continued to leverage the universal profile method and the half-face foundation application protocol established prior onsite. The panel was validated at home to confirm the performance was within good quality standards.

Results:

A subset of foundations were tested onsite and at home for application and up to 12 hours of wear. The after application attributes showed the most differences across all the products compared at home vs onsite, while few attributes consistently showed differences across the wear period. In the sensory mapping (MFA) of products tested onsite vs at home products shift positionally and in their clustering based off the testing location. The controlled testing conditions in the sensory panel booths produced a higher level of discrimination than the panelists' home conditions, which introduces more variability.

Conclusion:

These findings were pivotal in de-coding the sensory signature of the products based off evaluation location. While at home testing was a viable option temporarily, testing in the booths produces a more robust evaluation of liquid foundations.

Keywords: Sensory; Panel; Cosmetic; COVID-19; At Home; Remote

1. Introduction.

L'Oreal USA's Research and Innovation campus is the global hub for liquid foundation formulation and sensory evaluation. Characterizing the sensory performance of both marketed and prototype products through L'Oréal's onsite descriptive sensory panel is a critical stage in the product development pipeline. Classically trained sensory panels are designed to be very standardized in their testing methods and conditions. Due to the COVID-19 pandemic, L'Oréal's sensory panel testing in onsite standardized booths was put on hold To continue supporting our US labs and global partners, it was imperative for the sensory team to prioritize the development of a method to dispense and evaluate liquid foundations at home. This interim option allowed the labs to continue to move projects downstream and understand the sensory performance of their formulas in an agile way. With these agile methods established, the sensory team could better understand if the data collected at home reflects the specificity and discriminability of evaluations in onsite sensory booths. The aim of this paper is to present the guidelines developed for remote sensory testing and the impact of testing conditions on sensory performance of liquid foundation.

2. Materials and Methods.

2.1 Standardizing Conditions

Sensory booths are standardized testing locations with controlled conditions, see Table 1 for reference. The panelists were asked to identify a potential testing room in their home for evaluations to occur. The panelists were instructed to describe the conditions of the room such as lighting quality, temperature, sample storage, etc. The sensory team developed an optimal workstation to best standardize the at home testing conditions and mimic the booth as much as possible. Each panelist was provided standardized mirrors, cleansers, towels,

skincare products and ring lights. The ring light was calibrated to best match lighting conditions in the sensory booths. The panelists were instructed to set up their workstations with similar ergonomics as in the booths, see Figure 1.

2.2 Foundation At Home Dispensing Method

2.2.1 During onsite testing of foundation, the panel leader is responsible for preparing and dispensing the products to the panelists. Each product is pipetted using an Eppendorf Repeater device to hide the identity of the product and to ensure an accurate quantity is dispensed to each panelist. Due to the pandemic, the panelists had to take on the task of preparing and dispensing the foundation by themselves. The sensory team developed a new method to instruct and train the panelists on foundation dispensing. The below method was developed and proposed to the panel. Training was conducted by the sensory team in sessions via Microsoft Teams where the panelists practiced dispensing and evaluating.

2.2.2 Panelists were instructed to shake the vessel of foundation well to fully homogenize the product. The panelists were provided standard syringes and specific quantities for half-face application similar to the onsite protocol. Panelists fully submerged the syringe into the foundation vessel and filled to the 0.3 ml line. To maintain accuracy during application, panelists were instructed to avoid air bubbles in the syringes. Once properly filled, they dispensed and applied the formula according to the onsite half-face application protocol. The process was then repeated for the second product, which was applied to the alternate side of the face.

2.3 Virtual Connection

2.3.1 Prior to the COVID-19 pandemic, data was collected on paper ballots, however to digitalize the data collection process, FIZZ Web was used to deploy virtual online questionnaires and access data. Prior, the panelists were solely testing onsite, all communication was done in person and all data was entered in onsite computers located in the booths. The pandemic created an urgency to identify ways to connect with panelists

virtually. In order to create a virtual space for panelists to connect with each other and the L'Oreal sensory team, a Microsoft Teams channel was created for this group. In the channel the sensory team was able to conduct weekly trainings and the panelists were able to access protocols, videos and ask questions. Additionally, the panelists were responsible to manage their own workload. The panelists were upskilled through virtual trainings on new softwares such as Microsoft Teams, FIZZ Web, Microsoft Forms, Zoom, etc.

2.3.2 During this time, it was also important to maintain panel engagement. In order to boost morale, virtual team building exercises were conducted regularly. Group trainings were held in which the panelists were able to connect and learn from each other. This provided the panelists with a sense of normalcy and community, since the panel had primarily worked in group style settings previously.

2.4 Validation

The US sensory panel was created in the year 2000 for the evaluation of all makeup categories and is trained following International Standard ISO 11132 (2012). This existing sensory panel is re-validated yearly in the category of liquid foundation to confirm if the performance is within good quality standards and determine if trainings are needed. The objective of the validation is to assess the panel performance in the main criteria of discriminability, homogeneity and repeatability with quality standards >=70% of the total panel. Four liquid foundations were selected and evaluated based off their differing texture, application, and makeup result. During this study, the sensory panel consisted of 16 Caucasian women with normal to combination skin. The panel was fully validated on the three criteria both onsite and at home.

3. Results.

In order to analyze the data, multiple statistical methods were utilized. Initially, a table was created comparing the two locations (Table 1, Figure1). A Pearson's Correlation was conducted at the 95% confidence interval to highlight p-values greater than 0.75 and less than -0.75. This denotes high positive and negative correlation of the sensory attributes at home vs onsite (Table 2). In addition to the correlation, a Multi Factor Analysis (MFA) mapping space was created by leveraging the attribute vectors (Figure 3). A MFA mapping was created for each testing location with clustering based of Agglomerative Hierarchical Clustering (AHC) (Figure 4 & 5). In addition to the mappings, individual profile comparisons (t-Test 95% CI) were used to understand small differences between the testing locations for each formula (Figure 6 & 7). Using this combined analysis, we were able to conclude that there were differences in the sensory data collected between the testing locations.

Onsite Booths	**At Home**
Full standardized lighting	Some standardized lighting
Controlled dispensing by panel leader	Self-dispensing
Controlled sample storage	Uncontrolled sample storage
Controlled temperature	Uncontrolled temperature
Consistent water quality & temperature	Variable water quality & temperature
Evaluation scheduled by Panel leader	Panelist self-manage schedule
No mask usage	Evolving mask usage

Table 1 Testing Location Comparison.

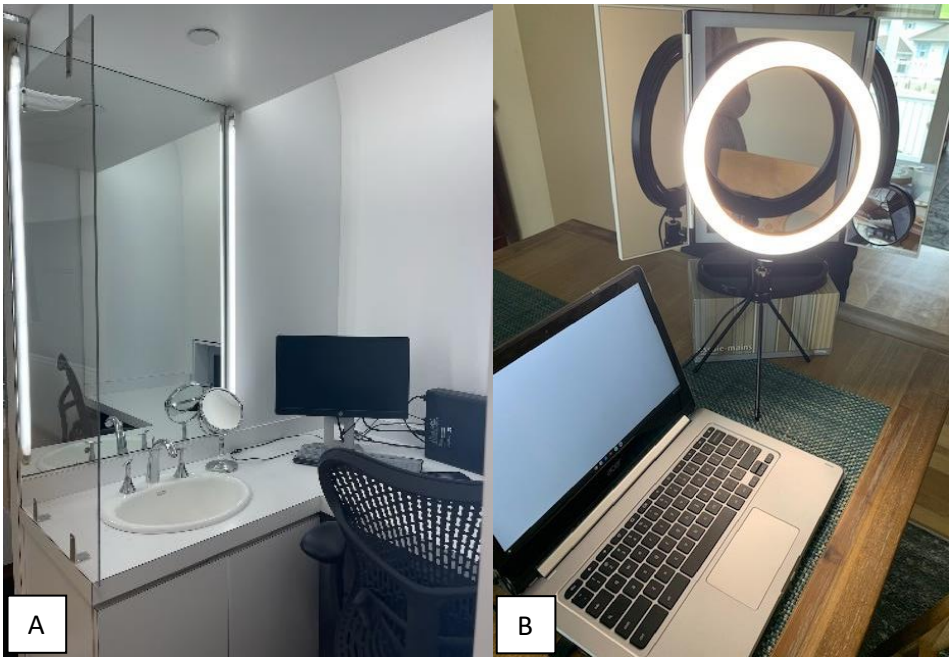


Figure 1 Workstation Comparison. *A- Sensory Panel booth workstation located at L'Oreal USA evaluation center (Clark, NJ). B- Panelist A at home workstation located in New Jersey.*

Variables	BA_KEEPS SHAPE_HOME	BA_SLIPPERYS_HOME	BA_SLIPPERY25_HOME	BA_THICKNESS_HOME	DA_THICKNESS_HOME	DA_DRAG_HOME	DA_FINGER GREAS_HOME	DA_TACK_HOME	DA_QUICKNESS DRY_HOME	DA_PILLING_HOME	DA_WETNESS_HOME	DA_COOLNESS_HOME	DA_FRAGINTENSE_HOME	AA_ADDDRY_HOME	AA_TIGHT/TAUT_HOME	AA_HEAVINESS_HOME	AA_OPAQUENESS_HOME	AA_HIDEIMPERF_HOME	AA_INTENSITY_HOME	AA_EVENDEPOSIT_HOME	AA_BLURLINES_HOME	AA_BLURPORES_HOME	AA_EFL_HOME	AA_ENHANCEPORE_HOME	AA_SHINE_HOME	AA_POWDERLOOK_HOME	AA_POWDERFEEL_HOME	AA_GREASE_HOME	AA_SILICONE_HOME	AA_TACK_HOME	AA_WAX_HOME	AA_SMOOTHNESS_HOME	AA_RESIDUETHICK_HOME	AA_IRRITATION_HOME
BA_KEEPS SHAPE	0.928	0.054	0.201	0.757	**0.681**	-0.468	**0.649**	0.518	**-0.669**	0.401	0.592	-0.181	-0.179	-0.343	**-0.656**	0.288	-0.406	-0.428	-0.299	0.022	0.572	0.229	-0.461	-0.378	0.865	**-0.827**	**-0.654**	0.823	-0.133	0.357	-0.420	-0.481	0.475	-0.263
BA_SLIPPERYS	-0.169	0.414	0.301	-0.395	-0.357	-0.200	-0.100	-0.085	0.006	-0.312	0.289	-0.312	-0.196	0.298	0.265	-0.238	0.060	0.010	0.046	-0.467	0.171	-0.076	-0.026	-0.017	-0.253	0.203	0.121	-0.245	0.464	-0.049	0.003	0.203	-0.239	-0.087
BA_SLIPPERY25	-0.220	0.585	0.538	-0.457	-0.526	-0.307	-0.213	-0.255	0.091	-0.068	0.478	-0.001	-0.468	-0.048	0.148	-0.510	-0.348	-0.369	-0.410	-0.346	0.320	0.299	-0.335	-0.340	-0.381	0.189	0.174	-0.369	**0.707**	-0.303	-0.006	0.256	-0.472	-0.223
BA_THICKNESS	0.791	-0.157	-0.092	0.937	0.899	-0.310	0.912	0.815	-0.882	**0.658**	0.422	-0.342	0.300	-0.374	-0.170	0.754	0.048	0.021	0.049	0.205	0.523	-0.044	-0.192	-0.037	0.860	-0.772	-0.845	0.811	-0.393	**0.735**	0.082	-0.782	0.504	0.051
DA_THICKNESS	0.547	-0.466	-0.407	0.801	0.799	0.050	**0.682**	**0.668**	-0.578	0.496	0.013	-0.208	0.483	-0.237	-0.055	0.788	0.223	0.221	0.265	0.301	0.149	-0.114	0.062	0.140	**0.665**	-0.514	-0.629	0.623	**-0.656**	**0.641**	0.186	**-0.685**	0.518	0.206
DA_DRAG	0.209	-0.571	-0.585	0.566	0.631	0.477	0.584	0.536	-0.400	0.084	0.078	-0.121	0.562	0.312	0.259	0.893	0.422	0.366	**0.658**	0.301	-0.132	-0.156	0.339	0.156	0.482	-0.407	-0.422	0.328	-0.741	0.511	0.121	-0.400	0.539	0.619
DA_FINGER GREAS	0.313	0.103	0.165	0.267	0.209	-0.519	0.124	-0.013	-0.199	0.370	-0.135	0.150	-0.174	-0.405	-0.353	-0.130	-0.072	-0.027	-0.299	0.321	0.268	-0.312	-0.183	0.052	0.178	-0.196	-0.030	0.337	0.122	-0.009	-0.131	-0.112	0.017	-0.453
DA_TACK	0.546	-0.274	-0.199	0.427	0.438	-0.298	0.257	0.404	-0.296	0.161	-0.214	-0.228	0.072	-0.268	-0.481	0.185	0.150	0.200	-0.023	-0.150	0.195	-0.249	0.107	0.324	0.408	-0.152	-0.279	0.550	-0.081	0.373	0.012	-0.451	0.452	-0.202
DA_QUICKNES DRY	-0.359	-0.257	-0.263	-0.197	-0.133	**0.742**	-0.230	-0.215	0.366	-0.396	-0.094	0.140	0.228	0.516	0.225	0.160	-0.022	-0.066	0.370	0.148	-0.560	0.243	0.144	-0.197	-0.093	0.039	0.153	-0.340	-0.586	-0.174	-0.154	0.310	-0.015	0.506
DA_PILLING	-0.439	-0.270	-0.427	-0.130	-0.046	0.466	0.124	0.105	-0.019	-0.137	-0.133	-0.131	0.472	0.513	0.853	0.488	0.606	0.551	**0.709**	0.157	-0.254	-0.395	0.424	0.277	-0.258	0.217	0.065	-0.344	-0.378	0.225	0.426	-0.034	-0.073	0.534
DA_WETNESS	0.033	0.359	0.391	-0.329	-0.337	-0.163	-0.327	-0.010	0.174	-0.131	0.099	-0.442	-0.172	-0.210	-0.234	-0.420	-0.409	-0.385	-0.429	-0.725	0.095	0.497	-0.324	-0.190	-0.102	0.235	-0.104	-0.156	0.244	0.019	0.053	-0.021	-0.268	-0.223
DA_COOLNESS	-0.237	0.055	-0.117	-0.104	-0.083	0.087	0.156	-0.073	-0.026	0.082	-0.021	-0.202	0.293	0.187	0.870	0.247	0.358	0.305	0.454	0.120	-0.054	-0.220	0.049	0.060	-0.238	0.171	0.068	-0.167	-0.144	0.068	0.305	0.024	-0.243	-0.157
DA_FRAG INTENSE	-0.043	-0.090	-0.156	0.376	0.518	0.251	0.215	0.336	-0.177	0.239	-0.447	-0.440	0.855	-0.137	0.178	0.539	0.432	0.425	0.362	0.209	-0.384	-0.172	0.273	0.483	0.370	-0.152	-0.426	0.244	-0.614	0.537	0.326	-0.205	0.152	0.335
AA_ADD DRY	-0.225	-0.180	-0.265	-0.060	-0.083	0.335	0.154	-0.075	0.013	-0.002	0.160	0.127	0.128	0.329	**0.689**	0.302	0.165	0.109	0.413	0.266	-0.077	-0.030	0.039	-0.186	-0.195	0.031	0.102	-0.234	-0.281	-0.059	0.135	0.033	-0.114	0.155
AA_TIGHT/TAUT	-0.164	-0.612	**-0.632**	-0.008	0.073	**0.643**	0.114	0.252	-0.014	-0.468	0.022	0.062	0.208	**0.739**	0.219	0.499	0.424	0.379	**0.657**	-0.023	-0.255	-0.231	0.548	0.179	-0.006	0.030	0.043	-0.174	-0.419	0.185	0.055	-0.085	0.389	0.846
AA_HEAVINESS	0.318	-0.556	-0.601	0.401	0.493	0.070	0.347	0.397	-0.216	-0.079	-0.363	-0.217	0.378	0.130	-0.001	0.498	**0.654**	**0.665**	0.568	-0.085	-0.092	-0.483	0.566	**0.645**	0.287	0.006	-0.123	0.484	-0.183	0.395	0.150	-0.346	**0.650**	0.022
AA_OPAQUENESS	-0.300	-0.815	-0.898	-0.100	0.039	**0.685**	-0.154	0.059	0.342	-0.473	-0.753	-0.010	0.514	0.498	0.336	0.387	0.790	0.815	0.816	-0.089	-0.630	-0.431	0.868	**0.730**	-0.236	0.511	0.298	-0.128	-0.403	0.127	0.332	-0.036	0.420	0.426
AA_HIDE IMPERF	-0.306	-0.812	-0.900	-0.134	-0.001	**0.705**	-0.159	0.020	0.362	-0.515	-0.706	0.002	0.473	0.563	0.381	0.377	0.766	0.782	0.845	-0.094	-0.627	-0.415	0.839	**0.664**	-0.260	0.511	0.332	-0.157	-0.416	0.085	0.289	-0.001	0.402	0.401
AA_INTENSITY	-0.173	-0.724	-0.827	-0.016	0.162	0.600	-0.030	0.190	0.197	-0.557	-0.623	-0.194	0.539	0.586	0.252	0.455	0.852	0.852	0.882	-0.237	-0.561	-0.474	0.909	0.795	-0.065	0.386	0.174	0.024	-0.328	0.250	0.242	-0.053	0.558	0.453
AA_EVEN DEPOSIT	0.035	0.824	0.879	0.082	-0.027	-0.615	0.084	-0.127	-0.303	0.608	0.481	0.131	-0.301	-0.555	-0.197	-0.335	-0.604	-0.613	-0.767	0.425	0.464	0.186	-0.729	-0.528	0.128	-0.449	-0.236	-0.014	0.289	-0.108	-0.157	0.105	-0.570	-0.227
AA_BLUR LINES	0.307	0.025	0.132	0.325	0.310	-0.290	0.198	0.273	-0.378	0.344	-0.067	-0.122	0.050	-0.164	-0.362	0.172	-0.118	-0.099	-0.180	0.356	0.220	-0.368	-0.262	-0.101	0.382	-0.406	-0.344	0.217	-0.508	0.354	-0.087	-0.319	-0.048	0.114
AA_BLUR PORES	0.095	0.202	0.306	0.116	0.119	-0.106	0.069	0.212	-0.296	0.131	0.198	-0.116	-0.028	0.054	-0.353	0.081	-0.287	-0.303	-0.240	0.226	0.160	-0.120	-0.309	-0.300	0.306	-0.426	-0.335	-0.041	-0.438	0.263	-0.175	-0.125	-0.175	0.454
AA_EFL	-0.459	-0.748	-0.856	-0.346	-0.230	**0.705**	-0.278	-0.063	0.458	-0.631	-0.603	0.076	0.314	0.625	0.459	0.218	**0.747**	**0.763**	**0.781**	-0.255	-0.574	-0.350	0.880	**0.651**	-0.483	**0.688**	0.476	-0.353	-0.124	-0.042	0.354	0.087	0.306	0.443
AA_ENHANCE PORE	-0.413	-0.599	-0.727	-0.413	-0.308	0.561	-0.302	-0.170	0.487	**-0.677**	-0.518	0.054	0.177	0.616	0.459	0.072	**0.680**	**0.688**	**0.722**	-0.349	-0.500	-0.315	0.790	0.586	-0.520	**0.707**	0.549	-0.321	0.071	-0.156	0.247	0.189	0.261	0.194
AA_SHINE	**0.696**	0.081	0.177	**0.657**	**0.636**	-0.505	0.511	0.409	-0.575	0.395	0.219	-0.144	-0.028	-0.351	-0.575	0.228	-0.118	-0.118	-0.211	0.177	0.408	-0.142	-0.226	-0.024	**0.703**	**-0.639**	-0.490	**0.723**	-0.073	0.347	-0.279	-0.360	0.382	-0.229
AA_POWDER LOOK	-0.316	-0.704	-0.755	-0.431	-0.337	**0.686**	-0.400	-0.110	0.557	-0.778	-0.483	0.011	0.108	0.632	0.206	0.035	0.457	0.478	0.607	-0.524	-0.536	-0.071	**0.694**	0.421	-0.438	**0.678**	0.471	-0.336	-0.100	-0.133	0.156	0.115	0.318	0.306
AA_POWDER FEEL	-0.437	-0.462	-0.512	-0.425	-0.353	0.756	-0.331	-0.170	0.465	**-0.634**	-0.204	0.058	0.136	**0.686**	0.378	0.104	0.233	0.209	0.536	-0.226	-0.512	0.067	0.411	0.053	-0.380	0.423	0.348	-0.486	-0.335	-0.156	0.068	0.218	0.050	0.496
AA_GREASE	0.622	-0.041	0.034	0.484	0.492	-0.401	0.298	0.257	-0.324	0.199	-0.084	-0.211	0.014	-0.258	-0.524	0.122	-0.025	-0.006	-0.084	0.030	0.200	-0.197	-0.120	0.097	0.546	-0.379	-0.301	**0.645**	-0.152	0.257	-0.268	-0.270	0.369	-0.399
AA_SILICONE	0.121	-0.318	-0.407	0.429	0.532	0.160	0.291	0.485	-0.152	0.307	-0.500	-0.507	0.827	-0.427	0.242	0.529	0.586	0.623	0.353	-0.217	-0.242	0.014	0.456	0.757	0.256	0.152	-0.404	0.420	-0.173	0.580	**0.643**	-0.472	0.401	0.006
AA_TACK	0.560	-0.172	-0.095	0.378	0.342	-0.443	0.283	0.358	-0.355	0.282	-0.111	-0.218	-0.050	-0.303	-0.366	0.131	0.046	0.092	-0.109	-0.067	0.357	-0.304	-0.094	0.141	0.336	-0.172	-0.269	0.475	-0.101	0.347	0.023	-0.488	0.258	-0.336
AA_WAX	-0.104	-0.229	-0.269	0.116	0.029	0.081	0.307	0.187	-0.224	0.369	0.188	0.178	0.087	-0.076	0.568	0.344	0.179	0.173	0.150	0.281	0.231	-0.082	0.029	-0.048	-0.174	0.033	-0.065	-0.136	-0.056	0.136	0.447	-0.323	-0.091	0.188
AA_SMOOTHNESS	**-0.667**	0.215	0.158	-0.549	-0.494	0.474	-0.524	-0.538	0.549	-0.438	-0.061	0.272	-0.024	0.372	0.218	-0.331	-0.117	-0.148	0.039	0.058	-0.501	0.266	0.092	-0.146	-0.433	0.273	0.423	-0.599	0.073	-0.487	-0.145	**0.665**	-0.354	0.322
AA_RESIDUE THIC	0.204	**-0.700**	**-0.698**	0.323	0.433	0.309	0.251	0.465	-0.185	-0.194	-0.410	-0.223	0.437	0.346	-0.049	0.594	0.613	0.622	0.627	-0.032	-0.205	-0.530	0.586	0.554	0.281	-0.013	-0.164	0.281	-0.556	0.492	0.158	-0.392	0.588	0.446
AA_IRRITATION	-0.350	-0.472	-0.486	-0.060	0.038	0.583	-0.015	0.250	0.005	-0.310	-0.172	0.064	0.326	0.524	0.154	0.410	0.443	0.430	0.473	0.080	-0.309	-0.306	0.569	0.335	-0.079	0.104	0.010	-0.298	-0.379	0.248	0.244	-0.082	0.203	0.998

Table 2 Sensory Attribute Correlation. *Pearson Correlation at 95% confidence interval. High positive correlation p-value > 0.75 signified by green cells. High negative correlation p-value <-0.75 signified by red cells.*

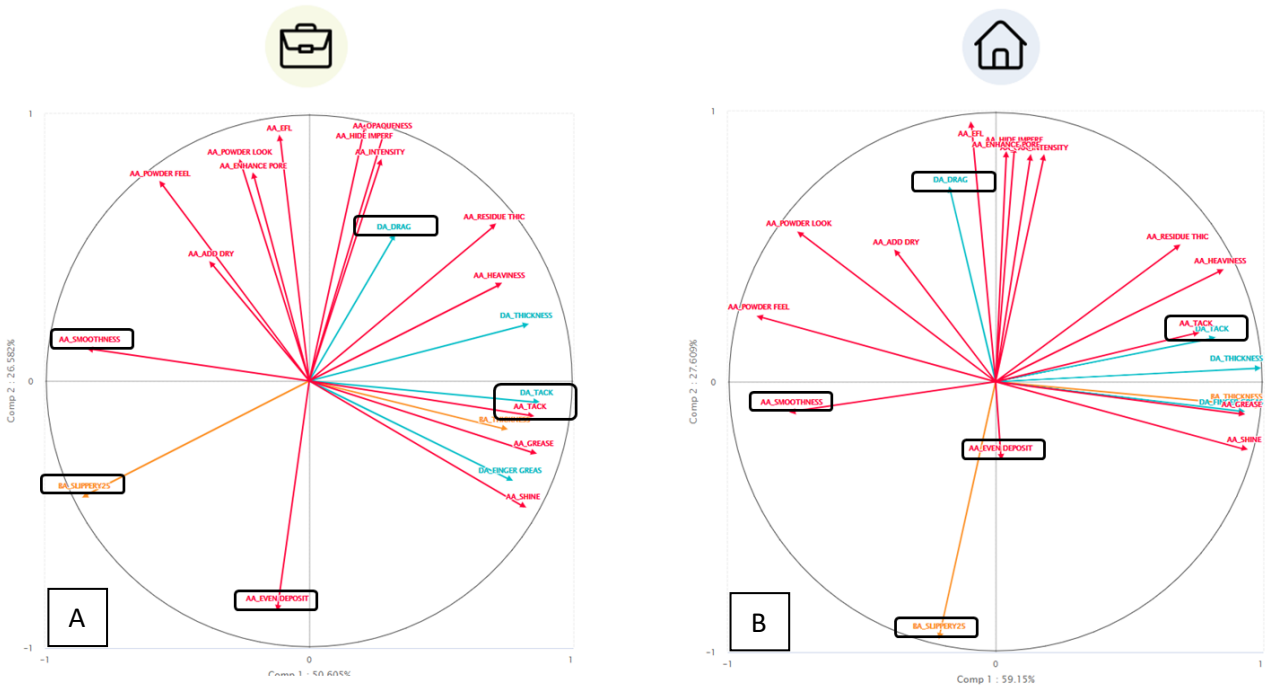


Figure 3 Sensory Attribute Vectors. *A- Onsite evaluation attribute mapping. B- At home evaluation attribute mapping.*

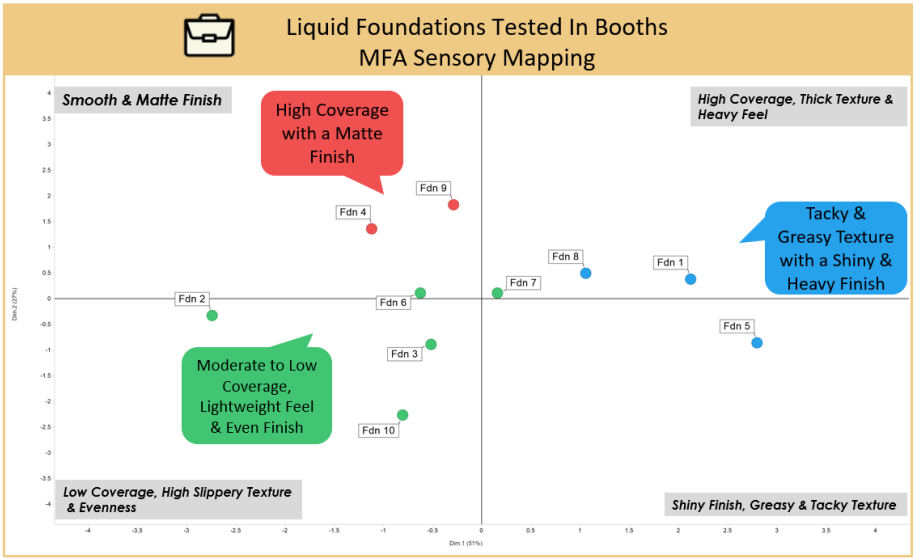


Figure 4 Onsite Sensory Mapping Multi Factor Analysis. *Three clusters are identified based of their texture and makeup result. Cluster 1 (red) is characterized by high coverage and matte finish. Cluster 2 (green) is characterized by low coverage, lightweight feel and even finish. Cluster 3 (blue) is characterized by greasy texture, tack and shiny/heavy finish.*

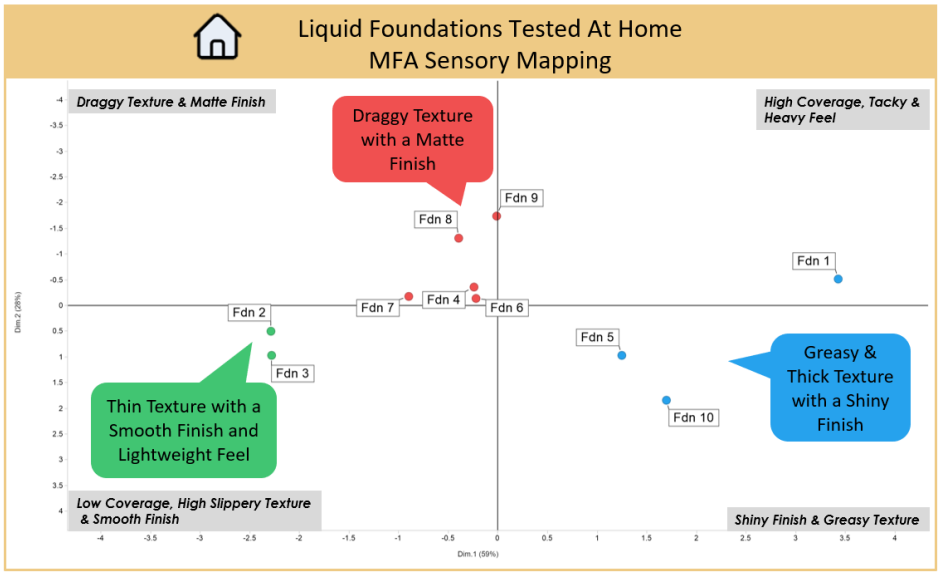
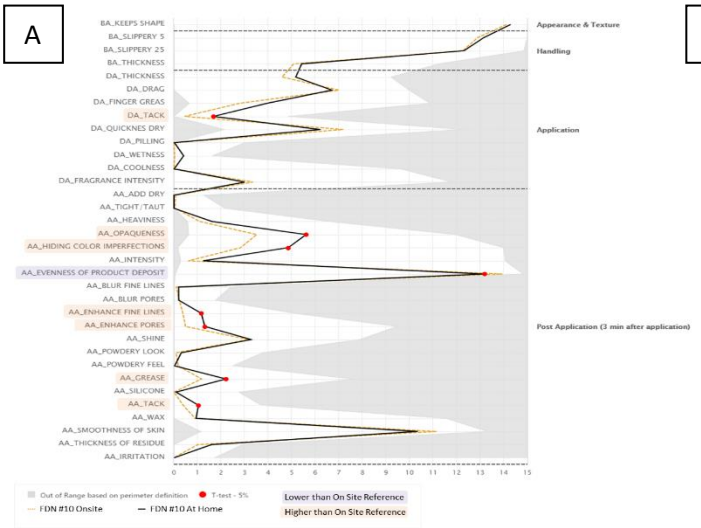


Figure 5 At Home Sensory Mapping Multi Factor Analysis. *Three clusters are identified based of their texture and makeup result. Cluster 1 (red) is characterized by drag and matte finish. Cluster 2 (green) is characterized by thin and slippery texture and a lightweight feel. Cluster 3 (blue) is characterized by greasy and thick texture, less drag and shiny finish.*

A

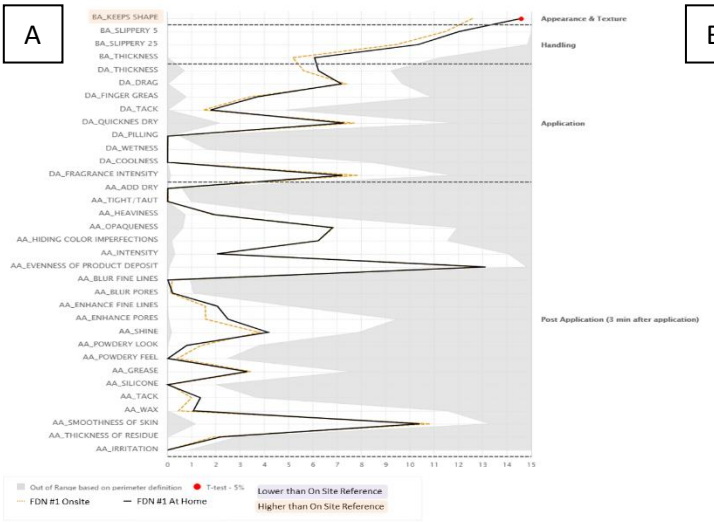


B

Attributes	4 Hour Wear	8 Hour Wear	12 Hour Wear
Added Moist			
Added Dryness			
Irritation			
Tight/Taut			
Heaviness			
Opaqueness			
Evenness			
Hiding Color			
Blurring Fine Lines			
Blurring Pores			
Enhancing Fine Lies			
Enhancing Pores			
Shine			
Powdery Look			
Powdery Feel			
Grease			
Tack			
Wax			

Figure 6 FDN #10 Sensory Profile Comparison (T-test). *A – Sensory profile comparison of onsite and at home data at application. B – Sensory profile comparison of onsite and at home data at all hours of wear.*

A



B

Attributes	4 Hour Wear	8 Hour Wear	12 Hour Wear
Added Moist			
Added Dryness			
Irritation			
Tight/Taut			
Heaviness			
Opaqueness			
Evenness			
Hiding Color			
Blurring Fine Lines			
Blurring Pores			
Enhancing Fine Lies			
Enhancing Pores			
Shine			
Powdery Look			
Powdery Feel			
Grease			
Tack			
Wax			

Figure 7 FDN #1 Sensory Profile Comparison (T-test). *A – Sensory profile comparison of onsite and at home data at application. B – Sensory profile comparison of onsite and at home data at all hours of wear.*

4. Discussion.

This study was conducted at the onset of COVID-19 in the United States. At the time, there was little or no information on conducting a cosmetic sensory panel fully remote and outside standardized booth conditions. The L'Oreal sensory team pioneered this method development and virtual ways of working with the panel. Using the findings of this study, we're able to confirm the differences between testing locations. Moving forward we are better equipped to modify at home testing conditions and produce more robust sensory data.

There were several variables that may contribute to differences seen in the sensory data collected at home vs onsite (Table 1). One part of the method that introduces more variability to the study is the difference in dispensing methods between at home and onsite testing. Onsite, the panel leader is responsible for dispensing each formula to the panelists while at home the panelists are responsible for self-dispensing. The Eppendorf Repeaters used by the panel leader are designed to be highly precise in their dispensing, while the syringes used at home require the panelists' accuracy to dispense the same quantity repeatedly. Not only did the at home syringes require more precision from the panelists, but also panelists had no prior

experience with syringes before this method. Though the panelists were all trained with the same method, there is still the potential for high variability between each panelist dispensing.

In the correlation (Table 2), there were attributes that were highly and moderately correlated between the testing locations. The attributes with high positive correlation were keeps its shape, thickness, opaqueness, hiding imperfections, intensity, and enhancing fine lines. The attributes with moderate positive correlation were powdery look, shine, grease, and smoothness. There were some positive trends correlated between at home and onsite, most of which are attributes related to makeup result. More training and exploration on non-correlated attributes could be done in the future to improve the correlation between at home and onsite.

Attributes such as slippery, drag, tack, even deposit and smoothness drive the mapping space slightly differently based on testing location (Figure 3). This produced different landscapes in which we projected the foundations onto. In the mappings, products shifted positionally and in their clustering based off the testing location.

When tested onsite, the foundation mapping space (Figure 4) was defined by 4 quadrants: (1) smooth & matte finish, (2) high coverage, thick texture & heavy feel, (3) low coverage, high slip & evenness and (4) shiny finish, greasy & tack. In the onsite sensory mapping, three clusters were identified based off their texture and makeup result. Cluster 1 (red) was characterized by high coverage and matte finish. Cluster 2 (green) was characterized by low coverage, lightweight feel and even finish. Cluster 3 (blue) was characterized by greasy texture, tack and shiny/heavy finish.

When tested at home, the foundation mapping space (Figure 5) was defined by 4 quadrants: (1) drag & matte finish, (2) high coverage, tack & heavy feel, (3) low coverage, high slip and smooth finish and (4) shiny finish & greasy. In the at home sensory mapping, three clusters were identified based off their texture and makeup result. Cluster 1 (red) was characterized by increased drag and matte finish. Cluster 2 (green) was characterized by thin and slippery

texture and a lightweight feel. Cluster 3 (blue) was characterized by greasy and thick texture, less drag and shiny finish.

While all the samples showed differences between at home and onsite, some products had more differences than others. Foundation #10 was an example of a product that had several differences between testing locations (Figure 6). Foundation #1 was an example of a product that performs similarly between testing locations (Figure 7). The makeup result attributes showed the most differences across all the products, which could be attributed to the lighting conditions of at home testing. The application attributes that showed the most differences are tack and grease. The attributes that showed the most differences during the wear hours are shine, grease, and powdery look which could also be attributed to mask wearing and the lighting conditions of at home testing.

The comparison of results of sensory data on liquid foundation in booths onsite and at home conditions indicated that the highest discrimination among samples was observed in booth conditions.

5. Conclusion.

The sensory mapping of products tested onsite vs at home produces a different picture of the sensory space. In the mappings we can see products shift positionally and in their clustering based off the testing location. The makeup result after application showed the most differences across all the products compared at home vs onsite, while few attributes consistently showed differences across the wear period. This could be attributed to the lighting conditions and self-dispensing during at home testing. The controlled testing conditions in the sensory panel booths produced a higher level of discrimination than the panelist's home conditions, which introduced more variability. These findings were pivotal in de-coding the sensory signature of the products based off evaluation location. While at home testing was a viable option temporarily, testing in the booths produces a more robust evaluation of liquid foundations.

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Conflict of Interest Statement.

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References.

1. International Standard ISO 11132 (2012).