Characterization of Oral Tactile Sensitivity and Masticatory Performance Across Adulthood

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Individual Variation in Texture Perception

- Inherent differences in human perception represent a major aspect of the variation in product judgements.

- The sources of the individual differences also shed light on the factors governing texture perception.
Masticatory Feedback Loop

- Chewing is driven by rhythmic contractions of muscles generated by central patterns in the brainstem.
- Tactile feedback is used to modify masticatory motor movements.

Tactile feedback is used to:

- Determine jaw placement and avoid discomfort while chewing due to an unintended collision of teeth.
- Locate and assess in the oral cavity food particles.
- Optimize chewing patterns to breakdown foodstuffs.
Oral Tactile Sensitivity

- Essick’s Oral Lingual Stereognosis
- Semmes-Weinstein Monofilament
- Granulation Discrimination
- Two-point Discrimination
- Roughness Threshold
- Pressure Sensitivity
- Etc.

It isn’t known which measures of sensitivity focus on how texture is perceived then **relayed back into the masticatory feedback loop.**
Test for oral sensitivity using oral stereognosis, lingual tactile acuity, and bite force sensitivity.

Quantify across age groups.

Relate to mastication performance

What measure of oral tactile sensitivity are important for chewing?
Participants

• N=98, 57% Female
• Screened by Age Group
  • 20-25
  • 35-45
  • >62
• Self-Report common dental procedures

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Age Group</th>
<th>Young</th>
<th>Middle</th>
<th>Old</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td></td>
<td>34</td>
<td>31</td>
<td>28</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td>22.5 ± 1.6</td>
<td>40 ± 3.1</td>
<td>73 ± 6.1</td>
</tr>
<tr>
<td>Age</td>
<td>Max</td>
<td>25</td>
<td>45</td>
<td>87</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>20</td>
<td>35</td>
<td>63</td>
</tr>
<tr>
<td>Gender</td>
<td>Female</td>
<td>22</td>
<td>18</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>12</td>
<td>13</td>
<td>12</td>
</tr>
</tbody>
</table>

* Mean values have SD as the error term.
Oral Sensitivity

Mastication Performance
<table>
<thead>
<tr>
<th>Oral Sensitivity Tasks</th>
<th>Oral Stereognosis</th>
<th>Confectionary Alphabet Letters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bite Force Sensitivity</td>
<td>2-AFC with foam of different compression factors</td>
<td></td>
</tr>
<tr>
<td>Lingual Tactile Acuity</td>
<td>10 Shape Stimuli (raised and recessed orientations)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stimulus</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Stimulus" /></td>
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</tbody>
</table>

Oral Stereognosis + Bite Force Sensitivity + Lingual Tactile Acuity = **Total Index**
• Mixing Ability
  • Two-color gum sample
  • 10 Seconds

Mastication Performance
<table>
<thead>
<tr>
<th></th>
<th>Age</th>
<th>Dental status</th>
<th>Masticatory performance</th>
<th>Stereognosis</th>
<th>Lingual sensitivity</th>
<th>Bite force sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>–</td>
<td>–0.5859**</td>
<td>–0.1037</td>
<td>–0.3978**</td>
<td>–0.3881**</td>
<td>–0.0593</td>
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<tr>
<td>Dental status</td>
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<td>0.1193</td>
<td></td>
<td>0.2364*</td>
<td>0.2244*</td>
<td>0.0485</td>
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<tr>
<td>Masticatory performance</td>
<td>–</td>
<td></td>
<td></td>
<td>0.0429</td>
<td>0.0657</td>
<td>0.0771</td>
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<tr>
<td>Stereognosis</td>
<td>–</td>
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<td></td>
<td>0.4648**</td>
<td>0.0027</td>
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<tr>
<td>Lingual sensitivity</td>
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<td></td>
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<td>0.0030</td>
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<tr>
<td>Bite force sensitivity</td>
<td>–</td>
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</tbody>
</table>

*Significant at the 0.05 level.
**Significant at the 0.0001 level.
Conclusions

• Individual differences were found for all sensitivity tests and masticatory performance

• Changes in oral sensitivity did not relate to masticatory performance

• Age was a significant factor in some measures of oral sensitivity
  • Aging effect is heterogenous – declines in some but not all
Test texture discrimination ability

Measure oral processing

Completed using two groups
- Low Sensitivity (Lower 25%)
- High Sensitivity (Upper 25%)

How does oral sensitivity relate to mastication and sensitivity to texture changes?
Discrimination Ability

- Triangle Testing
- Four different gelatin hardness’s:

Participants

High Sensitivity
N=11

Low Sensitivity
N=21
Oral Processing

- Jaw tracking utilized to determine masticatory behavior.
Discriminatory Ability
More common in individuals with low sensitivity (p < 0.05)

- High sensitivity participants were much more likely to have chews not fitting a pattern (p < 0.05)
- More dynamic mastication patterns are evidence of greater tactile feedback
  - Using tactile information to modify mastication pattern
Effect of Oral Tactile Sensitivity on Mastication Parameters

- Height (mm)
  - P < 0.05

- Closing Velocity (mm/s)
  - P < 0.05
Overall Conclusions

• Oral sensitivity scores modulated with age.

• Texture discrimination **not** influenced by oral sensitivity

• Mastication performance was **not** affected by sensitivity.

• Oral tactile sensitivity influences chewing behavior
References


Acknowledgements

- Zoe Resmondo
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sensory.tennessee.edu