

Ergonomic Analysis of LapDawg™



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To Be Ergonomic...

A product must

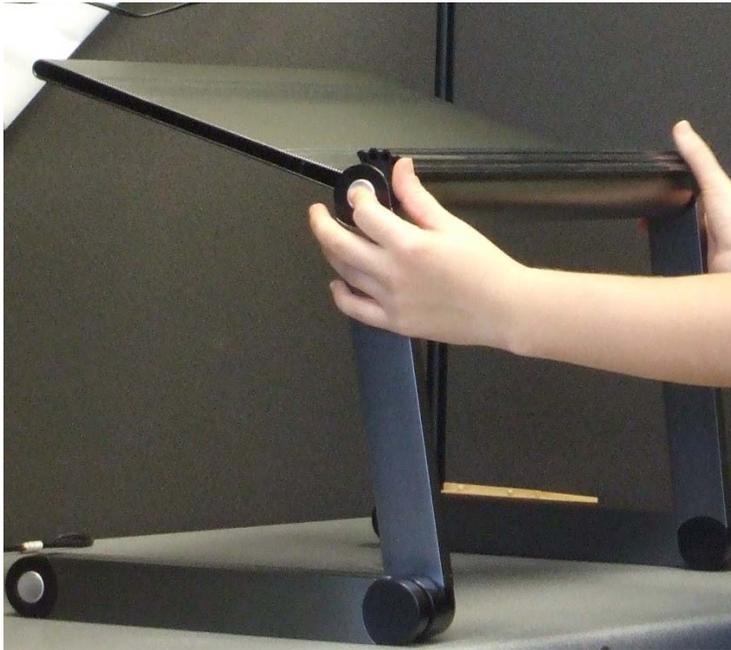
- Fit the user
- Be easy to use
- Improve comfort
- Improve performance
- Improve health and safety

Who might use the LapDawg™?

- Occasional & Full Time Laptop Users
- Business travelers
- Hotel businesses
- College students
- People in wheelchairs
- Children

BACKGROUND

Safety Issues



- Pinch Points on the leg hinges
- Heavy items might get bumped off the unstable surface
- The raised, rounded surface could cause wrist injuries

Limitations

- Requires two hands to adjust legs
- Requires agility and force to use buttons
- Legs have narrow bases
- Adjustment buttons can become inaccessible



BACKGROUND

Product Claims & Benefits

- “Helps with posturing and wrist stress reduction.”
- “not complicated to adjust”
- “fully adjustable”
- Cold surface good for laptop performance
- Easy to store and move
- Smooth and slip-resistant surfaces
- Rubber wrist rest eases the strain of repetitive typing

User Evaluations of LapDawg TM

- **Timed Setup & Reset** for 4 positions
- **Typing Speed** for 2 positions
- Examination of **Posture & Body Fit**
- **Comparison to Ideal Characteristics**
for a laptop stand

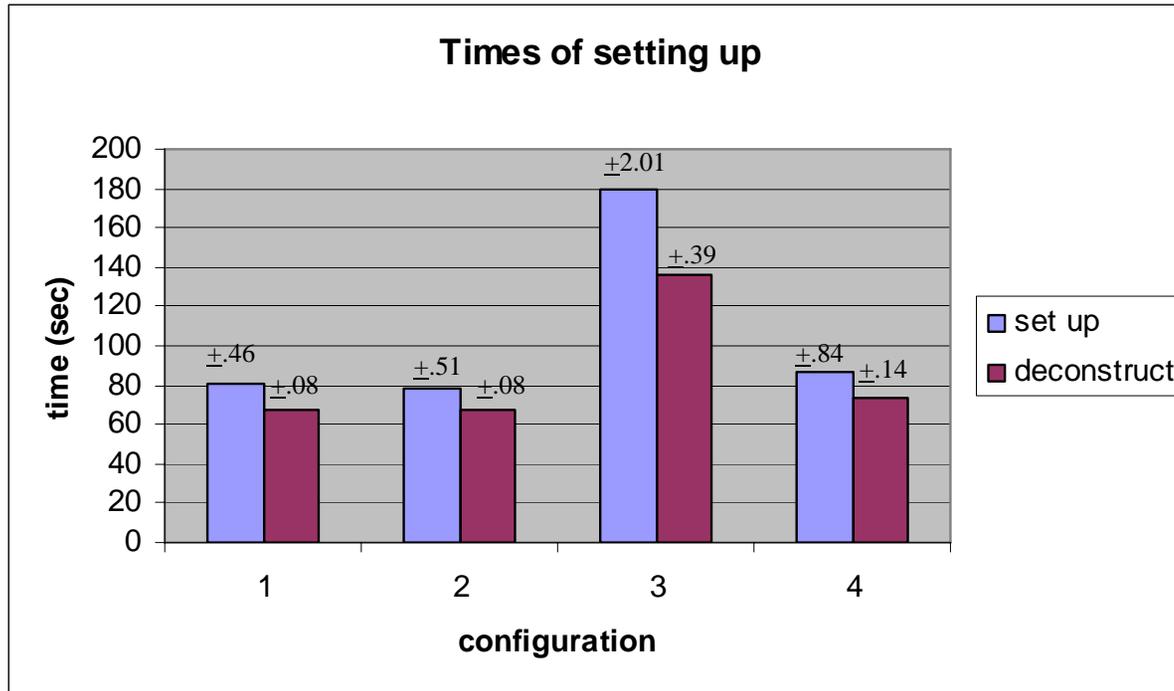
TESTING

Configuration Time

TESTING

Configuration			
1 (free standing)	2 (bed)	3 (table top)	4 (flipped free standing)
			

- Four configurations (above)
- Three subjects
- Randomized order of trials
- Subjects were timed on how long it took to configure each position, after looking at the directions only once before starting each position's configuration
- Each subject configured each position from the “out of the box” position, then were separately timed on how long it took to configure it back to the “out of the box” position
- This is a test of the product’s “Ease of Use”



- Configurations 1, 2, and 4 required **under 1.5 minutes** to set up.
- Configuration #3 was the most challenging
 - Average of 3 minutes to set up
- Subjects learned the sequence of motions required to set up the LapDawg™ from watching previous subject's successes and errors -resulting in faster configuration times for later subjects.

Typing on the LapDawg TM

TESTING

- Used a web-based typing test to evaluate typing speed in WPM
 - available at typeonline.co.uk
 - Text passages on the website are chosen at random and usually originate from a published book.
 - Passage lengths were on average 574 ± 12 words
 - Words consist of 5 characters including spaces
- Average baseline data obtained for subjects seated at a table and typing on a laptop with no stand at a comfortable height
- This is a test of the product's “performance”

Typing on the LapDawg™

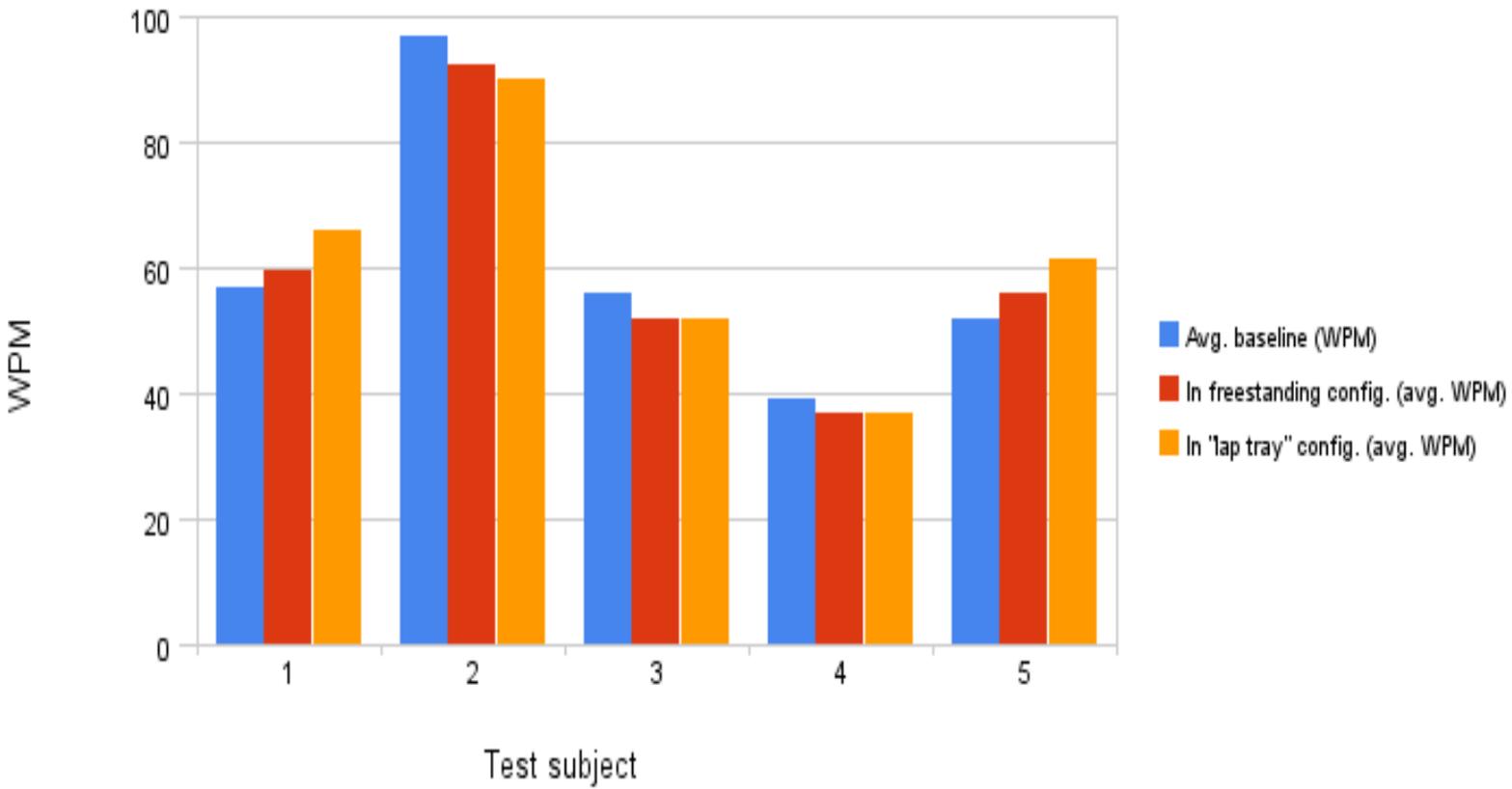
TESTING



- Two configurations tested:
 - “TV tray”: user seated in chair, LapDawg™ set up as small table
 - “Breakfast tray”: user seated on floor, LapDawg™ and laptop straddling user’s lap
 - Each subject did three typing trials in each configuration; results were averaged
 - Approx. 30 minutes rest between typing tests



Average WPM across different configurations, grouped by test subject



RESULTS

Typing Conclusions

- Mean words per minute (wpm) for 5 subjects
 - Laptop and desk (no LapDawg™) - **60 wpm**
 - LapDawg's TVtray position - **59 wpm**
 - LapDawg's Breakfast Tray position - **61 wpm**
- Using the LapDawg™ had no significant effect on typing speed, no matter the position.
 - Determined using an one-way ANOVA test

Posture & Body Fit Evaluation

Design Requirements For Computer Support Surface

- Ideal typing posture should be possible
- Placement should prevent twisting of body & neck
- Comfortable viewing distance should be emphasized
- Accommodation of an external Negative Tilt Keyboard & Monitor should be allowed

This is an examination of the product's affects on
“health and safety”

TESTING

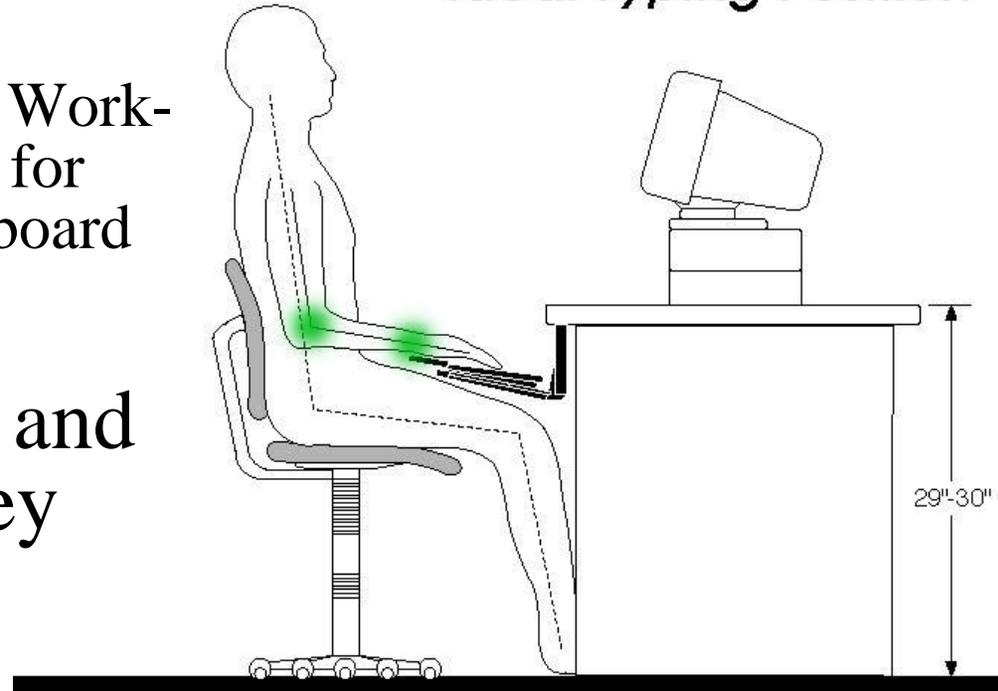
Posture Evaluation

23" to 28"

Recommended Work-Surface Height for Computer Keyboard

Wrist, Elbow and Neck are key angles

Ideal Typing Position



TESTING

Breakfast Tray Configuration

RESULTS



Hip Breadth, Sitting in inches

% ile	Males	Females
5 th	12.1	12.3
50 th	13.9	14.3
95 th	16.0	17.2

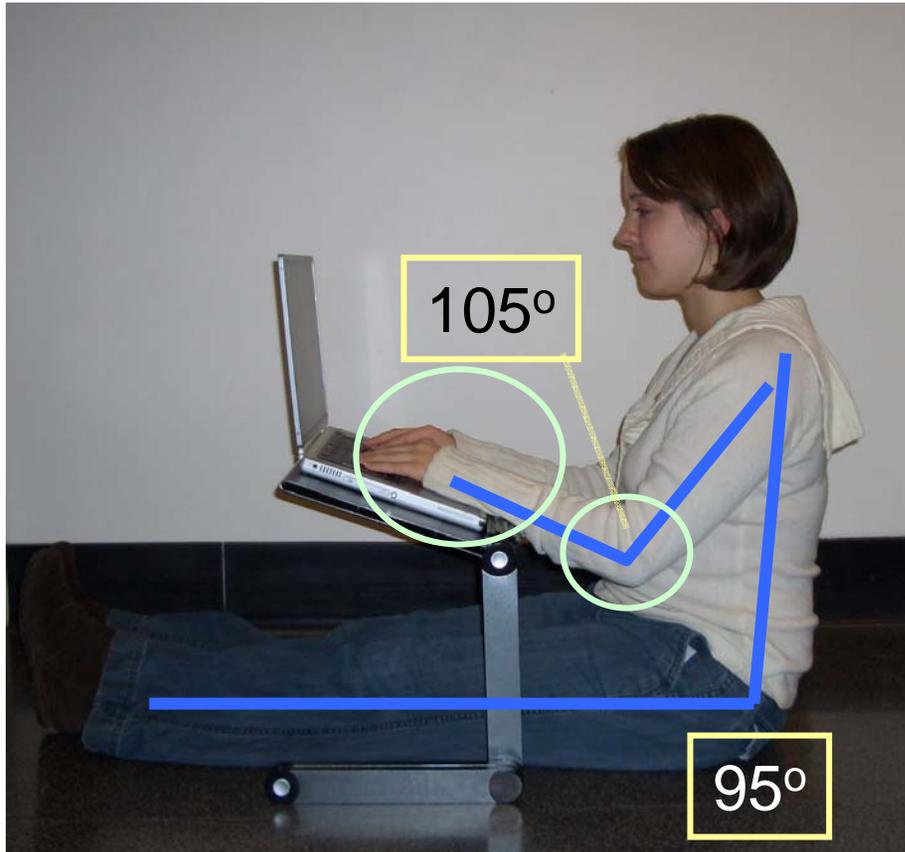
Thigh Clearance, in inches

% ile	Males	Females
5 th	4.5	4.2
50 th	5.7	5.4
95 th	7.0	6.9

This configuration will accommodate a full range of users.

Breakfast Tray Configuration

RESULTS



- Wrists are in a straight position
- Elbow angle is nearly 90°
- Lack of back support makes measurement difficult

TV Table Configuration

Knee Height, in inches

% ile	Males	Females
5 th	19.4	17.8
39 th	20.4	18.7
50 th	21.4	19.6
84 th	22.4	20.5
95 th	23.3	21.5

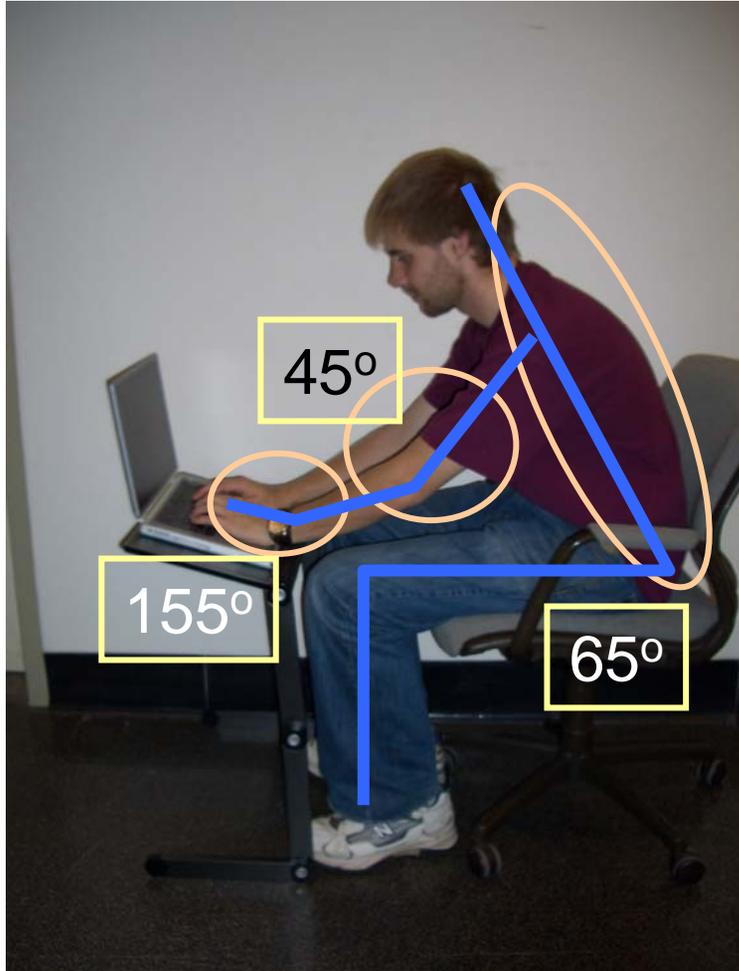
Height is *Too Low* for
61 % of Men
16 % of Women

This does not account for shoes, clothing, chairs, or other factors that might *increase* knee height.



RESULTS

TV Table Configuration



- Wrists are bent up
- Elbow angle is nearly flat
- Back and neck are tilted forward to see the screen
- This user has a knee height of 22"

RESULTS

Posture Concerns

Lower Extremities

- Is the person able to sit with the knees in a comfortable position?
 - The product will not be suitable for a large portion of the population in its “TV Tray” position.

Upper Extremities

- Is the person able to work with the head in a vertical orientation, such that the neck is not stressed by holding the head off balance from the neck and shoulders?
 - Laptop use cannot protect both wrist and neck safety simultaneously.
- Is the person able to reach to objects on the workstation without extended reaching, especially where the reaching is held for long durations, is repetitive, or requires trunk/torso deviations?
 - Because the product has a small surface area, users may need to reach the floor or other work-surfaces to access other documents or tools.

Posture Concerns

Is the person able to work with comfortable arm positions, or approximately...

- neutral shoulder positions (upper arms extended forwards)?
 - This is a concern in the “TV Tray” configuration.
- comfortable elbow positions that do not force shoulder or elbow positions from approximately neutral?
 - This is a concern in the “TV Tray” configuration.
- neutral wrist positions (hands in a straight line with the lower arms, hands not flexed down towards the palm not extended up, nor bent towards the little finger, nor bent towards the thumb)?
 - This is a concern in the “TV Tray” configuration.

Force Static Body Posture

- Does the workstation design and job requirements cause non neutral body positions to be held constant for extended periods of time?
 - This may be true if the user is a “full-time” laptop user.

Posture Concerns

Work-surface

- Is the width of the work-surface appropriate, such that all required task accessories and duties can be located within comfortable reach and viewing distance?
 - The surface area is large enough for one laptop. Users may need to reach other materials or devices that cannot fit on this surface.
- Is the area under the desk large enough to accommodate the legs and any accessories, such as footrests and arm rests?
 - The height of the “TV Tray” configuration is not tall enough for most users. This would preclude the placement of footstools or other apparatuses under the product.

The Ideal Laptop Stand

- This is a test of the product's "user satisfaction".
- Identification of User's requirements for an ideal laptop stand
 - Linear Analog Scale
 - Example:
 - Mark on the line with a slash(/) at the degree in which the ideal laptop stand should perform.
 - Comfortable / _____ Uncomfortable
- Evaluation of the user's opinions about the LapDawg™
 - Same survey as ideal laptop stand
 - Users asked to complete survey for 3 situations
 - Overall performance
 - Lap performance - partial survey
 - Freestanding performance - partial survey

TESTING

Ideal Stand Requirements

- Results from ideal laptop stand survey
 - The following items are most important to the users of laptop stands: (coefficient of variation in parenthesis)
 - Comfort (.03)
 - Configuring laptop should not require directions (.04)
 - Stable (.04)
 - Ergonomic (.08)
 - Enjoyable typing experience (.21)
 - Portable (.33)
 - Around \$25.00 (0.34)
 - Limited physical effort is need to configure stand (0.35)
 - Should protect the laptop from damage (.35)

Ideal Stand Requirements

- Results from ideal laptop stand survey
 - Users could not agree on the importance of including the following characteristics in a stand: (coefficient of variation in parenthesis)
 - Ability to disassemble stand (18.3)
 - Size of platform (15.7)
 - Manually vs. automatic adjustments (11.3)
 - Platform surface materials (7.3)
 - Platform adjustment once legs are in position (4.6)
 - Continuous vs. interval adjustments for height and legs (2.9)
 - Ability to use it in multiple positions (1.4)

Note: Some of these characteristics, such as size of platform and platform surface materials could be adjustable by the user. This would give the stand a bit of user participation and allow them to personalize the stand to their needs.

Ideal Compared to Existing

- When comparing user surveys of the LapDawg™ to the ideal laptop stand surveys, the following improvements to the product are suggested because of the significant difference in the expected result and the observed result of each important characteristic.
 - Level of comfort needs to be increased
 - Configuration process needs to be shortened
 - LapDawg should require less physical effort to configure
 - Ergonomic typing positions should be considered
 - The cost should be reduced
 - Configuration process should be more intuitive
 - The stand needs to be more stable when in use
 - The stand should provide more protection for the laptop
- Bed position vs. free standing position
 - Configuration and usability for the two positions were the same, except users felt the bed position was easier to configure than the free standing.

Ergonomic Suggestions

The LapDawg™ should...

- **Fit the user**

Suggestion: Users come in all shapes and sizes and the laptop stand should be able to conform to the user's body rather than the user conforming to it.

- **Be easy to use**

Suggestion: Configuring the stand should be fast for someone using it the first time, and not require overly detailed directions.

- **Improve comfort**

Suggestion: By making other improvements you will improve the comfort, however it should be considered that someone who finds the stand initially uncomfortable may decided not to keep it.

- **Improve performance**

Suggestion: Performance can go beyond typing but for typing alone consider proper posture positions and make sure the stand can adjust easily to them.

- **Improve health and safety**

Suggestion: Safety in this case also includes laptops and people not using the stand, bystanders, a small child near the unstable surface could be hit by a falling laptop or the laptop itself could be damaged. Consider making the stand more secure and stable.

CONCLUSION