

KUCHIBASHI: THE 3D-PRINTED TWEEZERS BIOIN- SPIRED BY NEW CALEDONIAN CROW'S BEAK

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INTRODUCTION

The tweezers were used in daily life, medical, engineering, and other various activities [2].

Problems

- Despite its casual use, optimal shapes for tweezers have not received extensive research attention [3].
- The tweezers are one of the medical equipment that gives anxiety to patients because of their inorganic and sharp shape [1].

METHOD

We proposed a new type of gripper bio-mimicking the New Caledonian Crow's (NCC) beak shape. NCC is dexterous as to use tools with its beak. Also, its beak is moderately rounded and organic which makes NCC beak shape tweezers look more accessible and friendlier than conventional tweezers.

DESIGN

We implemented a prototype reproduced following feature [4] of the NCC beak that used 3D Cad modeling and designing and 3D Printing manufacture (Fig. 1d).

Kuchibashi features 1) an overall length of 6.5 cm, 2) a length of approximately 2 cm from the fingertip to the tip, and 3) a handgrip section of 4.5 cm.

USER STUDY

In this user study, fingers, tweezers, and the prototype were compared by 2 pinching task (AllT & OneT) as quantitative study and questionnaire as qualitative study. The pinching task evaluated the task completion time of transferring the glass beads, and the questionnaire evaluated the overall usability in five-point scale with the reason of the rate as descriptive answer, and the possibility to use the prototype in the future (Fig. 2A,B).

RESULTS

Both AllT task and OneT task with 8mm beads and the additional experiment with OneT task in 14mm beads showed significance between tweezers and our prototype. And 5 level Likert Scale overall evaluation of the prototype (mean=4.19, SD=0.87). There were both positive and negative opinions about the reasons for the evaluation. 80% of the participants answered "yes" to the question of whether they would like to use Kuchibashi in the future. From this result, it can be explained that our prototype not only has comparable task completion time, and Kuchibashi's design, especially of impression of security and safeness were perceived overall positively from the participants.

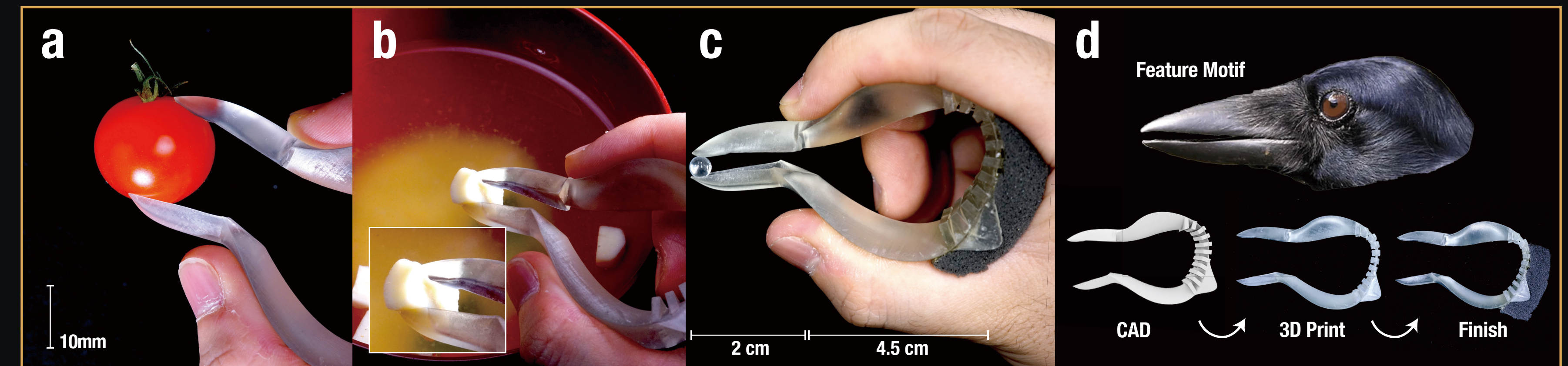


Figure 1: (a) cherry tomato picked up, (b) tofu picked up from miso soup, (c) Kuchibashi size scale and holding hands, (d) The New Caledonian Crow and how to implement Kuchibashi. "The New Caledonian Crow" by [4] used under CC BY / Background Removal from original.

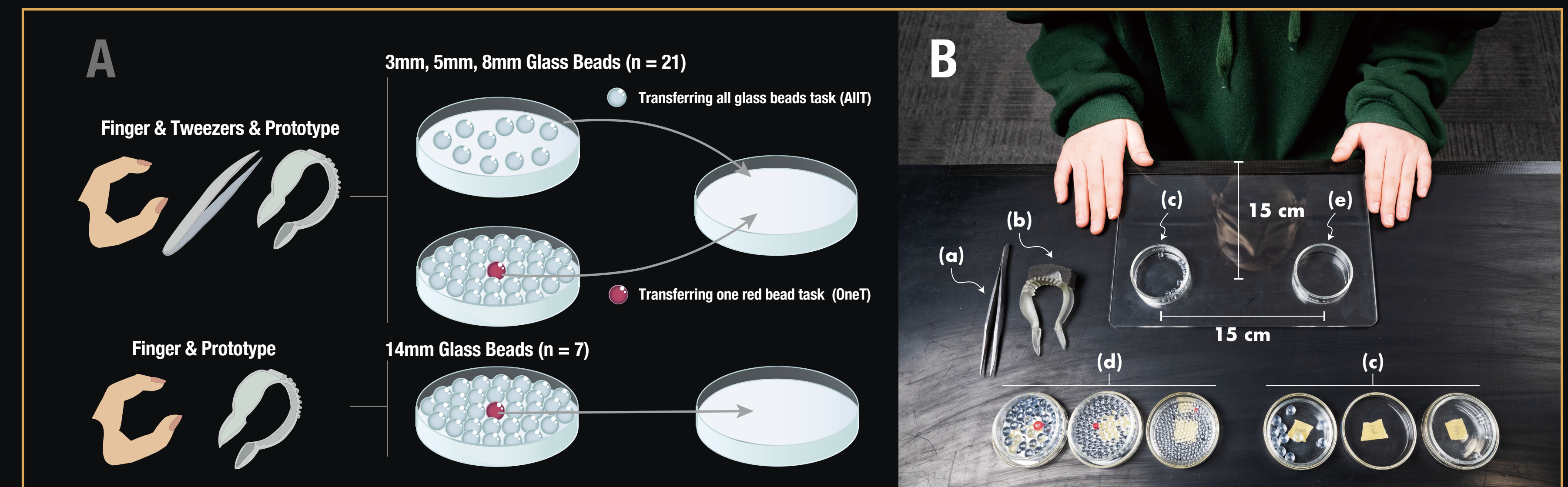


Figure 2: (A) User Study Design and Tool Combinations, and (B) Setup of the experiment. The pinching task was consisted of two tasks: transferring all 10 glass beads to a petri dish 15 cm apart (AllT) and transferring one red bead in the center (OneT). The task was done in order of AllT task then OneT with random combinations of tool and glass bead size. The OneT task of 14mm glass beads (OneT(b)) was done as additional experiments considering the results of the previous two pinching tasks.

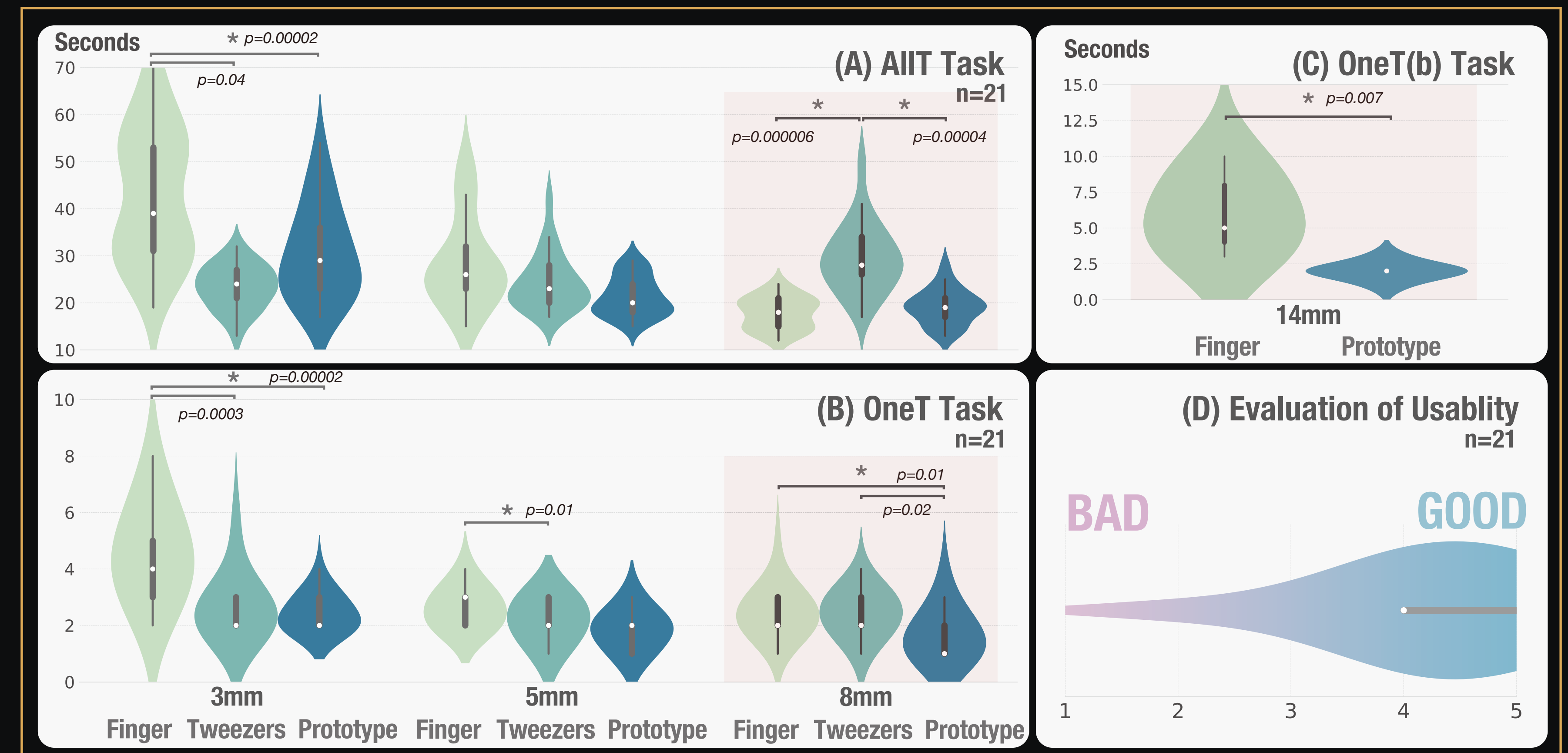


Figure 3: Result of (A) transferring all glass beads task (AllT), and (B) transferring one red bead task (OneT), and (C) additional 14mm task (OneT(b)), and (D) evaluated the overall usability. The results of pinching task completion time was analyzed by the Shapiro-Wilk test, Kruskal-Wallis test, Steel-Dwass test, and Bonferroni correction (* p<.05).

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