Relationships between Handwriting Slant and Demographic Feature

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Learning Overview: The goal of this presentation is to use statistical analysis to explore where there is a relationship between demographic features, such as handedness, gender and age, and attributes of a person's writing, such as slant.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by providing statistical support for relationships between demographic information and handwriting characteristics, such as slant.

While studies have been conducted on whether there are relationships between handwriting and demographic features, this study aims to provide statistical support for the relationships to handwriting slant specifically. Handwriting samples were collected from 90 adults [1]. Each participant completed three data collection sessions, each at least three weeks apart. Participants were asked to write three different prompts that have three different lengths: the London Letter being the longest, followed by an excerpt chosen from the book The Wonderful Wizard of Oz, and the phrase "The early bird may get the worm, but the second mouse gets the cheese" being the shortest. At each session, a survey was completed, and three writing prompts were each transcribed three times resulting in nine pages of samples each session. In total, there are 2430 handwriting sample images as well as demographic-specific information collected from surveys for all 90 participants. Survey data include information about the participant's handedness, age group, gender, location of third-grade education, and time of day in which the writing sample was taken.

These handwritten images are then broken into smaller segments of writing that we call "graphs" or "glyphs" by the handwriter R package [2][3]. We extract information such as curvature of the glyph, lengths, and heights, as well as shapes of the loops. Following the methods described in Crawford [4], these glyphs are then grouped according to their basic shape into 40 different clusters. For each glyph in a cluster, a quantitative measure of slant is computed. The slant of a writer is determined by calculating the direction of greatest variability in a letter using principal component decomposition and the angle of rotation corresponding to that direction. We call this the rotation angle of a glyph, which is a numerical value between 0 and 2π. In this study, we average the rotation angle of all the glyphs within a cluster for each handwriting sample as summary information. We also calculate the average rotation for all glyphs across all the handwriting samples for each person. We then fit a regression with the demographic information as explanatory variables and the average rotation angles as the response. Because rotation angles live on a circle, the regression model is based on a probability model appropriate for this type of data.

Based on exploratory analysis, it is hypothesized that females will have more of a slant in handwriting than males, left-handed writers more of a slant than right-handed, and younger age groups will have more of a slant than older age groups. In summary, this presentation aims to use statistical analysis to determine if there is a relationship between demographic features and slant.

References

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