J13 Dynamics of Stroke Direction in Genuine and Simulated Signatures

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After attending this presentation, attendees will learn empirical data about the dynamics of stroke direction.

This presentation will impact the forensic science community by providing Forensic Document Examiners (FDEs) with information that can be used in real casework.

A handwriting pattern is a sequence of ballistic strokes comprised of a series of upstrokes and down strokes, which may or may not be concatenated. Forensic Document Examiners (FDEs) consider the movement, shape, and formation of upstrokes and down strokes when determining the authenticity of handwriting. Osborn (1929) noted that upward connecting strokes were significant for the comparison of movement impulses and the relative smoothness of downward strokes was indicative of genuine or fraudulent writing.

In this study, each of 60 writers provided ten genuine signatures and 15 simulations of three model signatures. The model signatures were in three styles – text-based (where all the allographs are legible); mixed-style (where two or more allographs are legible); and stylized (where no more than one allograph is legible). The signatures were collected on specimen checks, which lay on a digitizing tablet that was connected to a laptop computer running MovAlyzeR® software. The resulting database comprised 600 genuine signatures and 1350 simulations in hard copy form and in electronic form with dynamic data.

The data were processed to extract five parameters from each pen stroke: stroke duration; stroke length; stroke velocity; normalized jerk; and, average pen pressure. Kinematic data for the upstrokes and down strokes were coded on the basis of the direction of the velocity trace for a given stroke. For each writer, the average value of each of the five kinematic scores was calculated for upstrokes and down strokes for the genuine and simulated signatures yielding 240 scores for each kinematic parameter.

A mixed model analysis of variance (ANOVA) was used to test main effects of writer style (text-based, mixed, stylized) and condition (genuine and simulated). Upstroke-down stroke difference scores were calculated and t-tests were used to evaluate differences between genuine and simulated conditions for each writer group.

Results supported previous findings showing differences between upstrokes and down strokes for genuine signatures along several kinematic parameters including stroke length (19% longer for upstrokes), stroke velocity (15% higher for upstrokes), and pen pressure (14% lower for upstrokes) across writer styles. The study revealed new findings on differentiating simulated from genuine signatures based on analysis of upstroke/down stroke ratios. Specifically, it was found that the ratio for stroke length was significantly greater in simulated than genuine signatures for stylized writers, but lower in simulated signatures for text-based or mixed writers. For stroke velocity an increase was observed in the ratio (from 18% to 31% greater velocity for upstrokes) from genuine to simulated signatures for stylized writers. Lastly, it was found that stylized writers exhibited lower pen pressures for upstrokes than down strokes (11%) for simulated signatures, which was not observed for genuine signatures. For all other writer groups, consistently lower pen pressures for upstrokes than down strokes were observed for both genuine and simulated signatures. Using existing tools, FDEs can evaluate stroke length and pen pressure from known and questioned historical documents for judgments of authenticity. These findings suggest that accurate measures of stroke length and calculating the upstroke/downstroke ratio or difference can increase the scientific rigor of judgments of authenticity.

Handwriting, Dynamics, Strokes

 ** Presenting Author*