Familiarity Effect in the Perception of Handwriting: Evaluating in-group/out-group Effect among Readers of the Latin Script

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Abstract: There is much evidence that familiarity can affect perception of stimuli, with items that are familiar to the individual being preferred and better remembered. Previous research has also shown that familiarity with a typeface increases preference for it, but no studies have evaluated the impact of familiarity in relation to the affect towards handwritten text. For the present study, a two-part experiment (*N* = 422) was designed to measure how contemporary users of the Latin script perceive handwritten text. The first section was designed to collect specimens of the participants' handwriting. The second, which was adapted to each participant's handwriting style, measured implicit judgments of certain familiar letter shapes against unfamiliar ones. Results show that familiarity positively influences the extent to which one judges the friendliness and trustworthiness of handwritten text. Furthermore, the greater the similarity to how one writes a letterform, the greater the observed effect in terms of perceived friendliness. These findings suggest that people have an implicit bias towards handwriting that looks like their own.

Keywords: Handwriting, implicit judgment, in-group out-group bias, Latin script

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1. Introduction

1.1 Familiarity

When something is familiar, it is often perceived as more comfortable or easily processed (Aronson et al., 2010). Familiarity can apply to several aspects of life, such as people, places, and objects; and it plays a significant role in shaping decision-making (Gulati & Sytch, 2008), preferences (Liao et al., 2011), and how individuals interact with their surroundings (Beckes et al., 2012). The effects of familiarity can be explained by the familiarity principle, also known as the mere-exposure effect. This model posits that individuals exhibit a strong inclination towards concepts, objects, or information that is familiar to them. Robert Zajonc initiated a discussion of this effect in a landmark review paper published in 1968 in the Journal of Personality and Social Psychology. In this monograph, he covered an array of studies, which he later used to extrapolate the theory that even a single exposure to a stimulus is sufficient to result in an enhancement in the subject's attitude towards that stimulus. His early studies proved that more-familiar words were preferred over new ones with which participants had not been acquainted. These judgments were later observed to take place very rapidly, and usually implicitly (Zajonc, 2001; Zizak & Reber, 2004), meaning users are typically unaware that they carry such bias.

The familiarity heuristic (Ashcraft, 2006) stands as another paradigm aiming to explain this same phenomenon, but in this case, it is the cognitive process of memory what is used as a factor for preference. This model states that people's preferences are guided by things that seem and feel familiar simply because they're easier to access, as they are based on previous experience (Schwikert & Curran, 2014). This scaffolding paradigm has developed in the last 30 years. Now, there is a consensus that situations familiar to the user are better remembered than those classed as novel, as the former build on information that has already been stored (Sutton, 2015). In a nutshell, experience of an item leads to increased memorability and greater preference towards it. The opposite shows the reverse effect, with less familiar stimuli being rated as less likable and more forgettable (Liao et al., 2011).

Another notable paradigm based on the notion of familiarity is the in-group/out-group bias (Taylor & Doria, 1981). This paradigm, which was first introduced from the perspective of social psychology, demonstrates a tendency in people to see the world in a dichotomous way, where the "us" and the "they" are both easily traceable. This grouping tends to be accompanied by an inclination or preference towards one's own category, resulting in in-group favouritism (Aronson et al., 2010). This suggests, similar to the previously discussed literature, the existence of a bias in favour of items or things that the beholder sees as sharing characteristics with. This preference is also often implicit, with little to no conscious awareness of the bias on the part of the person displaying it (Devos & Banaji, 2006). Additionally, the in-group is usually subject to social projection, a phenomenon that causes the beholder to expect traits similar to their own on others (Robbins & Krueger, 2005; DiDonato et al., 2011; Machunsky et al., 2014).

1.2 Predictability of typefaces

Reading is a complex process that engages various cognitive domains, encompassing visual, phonological, orthographic, cognitive, and lexical processing. Success in reading involves the reader's ability to recognize and distinguish individual shapes as letters. To achieve this, the letter needs to be shaped in an expected way (Pelli et al., 2006). The ease of recognition is intimately linked to the concept of 'predictive coding' (Hohwy, 2013), a cognitive theory positing that the brain operates based on preconceived expectations, only shifting attention when confronted with deviations from these expectations. This suggests that reading materials designed to align with familiar visual presentation and rule sets support predictive coding mechanisms, thus promoting smoother reading experiences.

Previous studies that examined the effects of practice sessions on reading unfamiliar typeface styles have yielded differing results depending on the test fonts and methodologies employed. While some studies found that after short practice sessions, participants showed improvement in identifying unfamiliar characters (Pelli et al., 2006) and increased their reading speed more with unfamiliar typeface styles than with familiar ones (Beier & Larson, 2013; Nedeljkovi□ et al., 2020), others found no improvement of sentence reading with their unfamiliar font stimuli after practice (Bernard et al., 2016). We have yet to succeed in identifying similar studies into the effects of familiarity with handwritten text.

1.3 Semantic associations of typefaces styles

Several researchers have found that typefaces can trigger 'semantic associations' in readers. In one study, participants ranked fonts based on traits like confidence, coldness, friendliness, or relaxation, and consistently attributed the same traits to the same fonts (Brumberger, 2003). These findings were replicated using other personality descriptors, like cold, elegant, or feminine, proving strong associations made to each typeface (Jordan et al., 2017). Moreover, these associated traits affect the overall perception of text, impacting the reader's attitude toward the message they're reading altogether (Kim et al., 2021). Others have found that when a word's personality trait matches the font's personality trait, participants read the words faster (Hazlett et al., 2013) and that font style can be matched to tastes like sweet, sour, salty, and bitter (Velasco et al., 2015). In a review paper, Schroll et al. (2018) concluded that typefaces that appear handwritten tend to enhance the perception of human presence, leading to greater emotional attachment to the brand. The use of handwritten typefaces within consumer brands can also pose challenges due to their poorer readability. Participants may perceive special fonts as unique in style but unfamiliar and harder to read, leading to less favourable product evaluations (Wu & Kardes, 2021).

1.4 Processing of familiar handwritten letterforms

It has been shown that when participants are exposed to shapes resembling familiar handwritten letterforms the process will activate the premotor brain area, used for writing (Longcamp et al., 2003; Longcamp et al., 2011), this sensorimotor relationship disappear when the letterforms are displayed as printed text (Longcamp et al., 2006; Wiley & Rapp, 2021). Wamain et al. (2012) have demonstrated that the brain handles handwritten letters differently depending on how familiar participants are with the associated hand movements, namely, whether the letters are written by the participants themselves, by others, or whether they are shown as printed text. The researchers found that the part of the brain which controls movement significantly influences our processing of handwritten letters as early as 300 milliseconds after exposure, with the most pronounced effect observed for familiar letters written by the participants themselves, highlighting the positive influence of familiarity.

Another study (Vinci-Booher & James, 2020), which also measured brain activity of participants exposed to letterforms written by themselves, by others, and printed letters, identified different patterns between child and adult participants in how the brain recognizes the three categories of letterforms. The researchers proposed that the visual perception of variations among the different handwriting styles could influence developmental changes in the neural systems underlying letter perception. The sensorimotor relationship in the perception of reading further has strong pedagogical implications (Vinci-Booher & James, 2020), as poor writing ability is linked to poor reading ability in young literate children (James & Engelhardt, 2012; Young et al., 2015), and reading acquisition is facilitated by handwriting learning in young pre-literate children (Karin & Engelhardt, 2012).

1.5 Rationale

The available research shows familiarity plays a role in the perception of stimuli. Individuals prefer things that are more familiar to them, effect that has been observed relative to print type. When it comes to handwritten text, familiarity has been observed to affect the processing of letterforms, but no research has been performed on the preference effects of familiarity on this type of text. On this foundation, the current study was designed to evaluate the effects of familiarity on preference of handwritten letterforms.

1.6 Conceptual framework

To identify which handwritten styles are familiar to an individual, one would think taught writing models are a good starting point. If one examines how the Latin script is introduced to schoolchildren, it is easy to identify national or regional variations, with clear differences between them. Expecting these models to predict familiar writing, though, is a faulty assumption, as individual differences such as gender (Peeples & Retzlaff, 1993) or personal background (Yang et al., 2022) have shown to severely influence handwriting style. To evaluate familiar handwriting across groups, an analysis of six handwriting databases (CEDAR, 1993; TUAT, 1997; IRONOFF: Viard-Gaudin et al., 1999; UNIPEN, 2011; MAYASTROUN: Njah et al., 2012; CSAFE, 2019) was carried out. The databases, which contain rich metadata about each writer, are repositories of individuals' handwriting, usually used to train algorithms primarily in optical character recognition. These databases contain specimens produced in an extended time period (1993-2019), making writing styles vary widely between time stamps and ages. The decision was therefore taken to collect new handwriting data and use each individual's writing style as a reference for familiarity. This ultimately resulted in a new repository as a by-product of this study. The handwritten specimens collected for the present research (around 12,000 sentences written by 566 participants in 29 languages) have all been made public in the form of a freely available online database on commercial type foundry Typotheque's website (Mangas Afonso, 2023).

Once the hundreds of specimens had been collected, the aim was to measure the bias for the individual's familiar letter shapes against those the user did not employ. To ascertain this, each respondent was sent a survey, individually programmed to show letterforms they proved to consistently use in their specimen. The survey would assess implicit judgments the participant made towards familiar and unfamiliar handwritten letterforms. To measure them, five dimensions or descriptors were decided upon: trustworthiness, friendliness, and readability, as well as differences in the perceived age and gender of the person writing the letters. These were therefore set as the five dependent variables of this study, subordinate to a binary independent variable: the participant's use of a specific letterform.

The decision to isolate these five dimensions was based on previous literature and aimed to measure the perceptual bias towards familiarity from a variety of angles. Perceived trustworthiness was selected, as literature shows it follows a positive correlation with familiarity (Gulati & Sytch, 2008; Schmitz, 2008; Seegers, 2009; Alarcon et al., 2016). For perceived friendliness, it has been observed that familiar stimuli are perceived as happier (Carr et al., 2017) and more affective (Claypool et al., 2007; Garcia-Marques et al., 2016), two indicators of friendliness (Scherer & Wallbott, 1994). Engaging content is more prone to being anthropomorphized (Epley et al., 2007), and familiarity breeds empathy (Motomura et al., 2015; Beckes et al., 2012; Abramson, 2021). For these reasons, the projection effect was expected, as it happens on members of the in-group (Robbins & Krueger, 2005; DiDonato et al., 2011; Machunsky et al., 2014). The perceived age and gender of the person writing the stimuli were also measured. It was expected that familiar shapes would be perceived as written by someone closer in age and gender to the observer than those that were unfamiliar. Lastly, readability was also measured to explore its interaction with the other dependent variables, as well as with familiarity, as previous research has proven less familiar text is also less legible (Beier & Larson, 2013).

Against the previous background, the following hypotheses were posed: First, (H1) familiarity of handwriting letterforms is expected to **increase perceived trustworthiness** against unfamiliar letterforms to the reader. Secondly, (H2) familiarity of handwriting letterforms is expected **to increase perceived friendliness** against unfamiliar letterforms. Lastly, a third hypothesis (H3) was set, expecting familiar handwritten letterforms to be perceived **as closer to the reader's age and gender** than unfamiliar shapes, caused by a projection effect.

2. Methods

2.1 Pilot

To explore the extent to which each hypothesis was worth investigating, a pilot study was designed. It was created as a version of the full-scale study, but with a smaller sample size (N = 30). The results from this pilot also helped fine-tune the design of the subsequent research, improving both the methods used and participant recruitment. The 30 participants that completed the pilot were sampled in libraries and other public places of Barcelona and Santa Cruz de Tenerife, Spain (Catalan and Spanish) and distributed within Typotheque's community as well as online (for Dutch and English). The sample consisted of 17 males, 13 females and one non-binary person. These ranged from 18 to 64 years of age, with an average of 28.4.

Throughout the pilot, qualitative data on the participants' perception of the experiment was collected, as they were prompted to think out loud. They were also questioned as to whether they had noticed anything out of the ordinary at the end of the experiment. Other open-ended questions were asked, in order to estimate the perceived complexity of the experiment and identify potential pitfalls in its design. Additionally, the participants were encouraged to speculate as to the purpose of the experiment. Regarding the handwriting collected during the pilot, the data showed that while writing, participants did indeed often but not always draw region-specific shapes, which related to the handwriting model of their country. It was also observed that participants rated the shapes they used differently from those of others when it came to trustworthiness and friendliness.

Each rating was accompanied by confidence ratings, using a 5-point Likert scale. Participants of the pilot became significantly more insecure about their answers as the experiment progressed. For this reason, a control stimulus was later introduced into the full study to measure the extent of such insecurity (for this control stimulus within the display order, see Figure 1). By measuring reactions to the same stimulus twice throughout the experiment, this bias could be counteracted. The non-sense word "stne" would be shown at the very beginning of the survey and halfway through, drawn identically both times. Other changes that were introduced after the pilot included:

improved instruction slides, substituting 5-point Likert scales with graphic rating scales that provided a score from 1 to 100, and removing an item that measured "trendiness" of the letterforms. Additionally, it was after the pilot that it was decided to investigate readability as an additional co-variate. The remaining methods stayed the same.

2.2 Methods

The experiment was divided into two parts, one to collect samples of individual participants' handwriting and one to measure perception of handwriting. The first part of the experiment used a copybook-like form that prompted the participant to write down a series of sentences, in order that their natural writing could be collected. Four types of handwriting were measured: minuscule handwriting, majuscule handwriting, initial majuscules, and numerals.

Pangrams were used for minus- and majuscule handwriting, given that each of these would make the participant write all the letters of the alphabet in a natural way (the pangrams were mainly obtained from Rutter, 2014). For majuscules, a list of places and people's names was drawn up and incorporated into naturally sounding sentences. Versions of the form were produced in French, German, Portuguese, Polish, Italian, Croatian, Romanian, Slovak, Turkish, Indonesian, Czech, Swedish, Hungarian, Finnish, Danish, and Vietnamese. The 20 printable forms were made available as PDF files on the call's website. These were designed to be printed and scanned, with spaces left for handwriting, and scanning guides were also supplied online. In addition, a non-printable version of each form was prepared for users with no access to a printer. This adapted version provided instructions on how to successfully produce and submit specimens on blank paper.

For recruiting, a call for participants was published online. Sampling was mainly obtained organically, via the open call's website and other communication outlets—especially Twitter and Instagram. To supplement the sampling, the participant recruitment platform Prolific was also used. This improved the representativeness of the sample, supplying participants from under-represented backgrounds.

2.3 Procedure

After completing the handwriting form and scanning it, participants were prompted to upload their handwriting specimen, together with demographic information. This consisted of age, gender, mother tongue and languages spoken, level, location and field of education, occupation, handedness, and learning disabilities. Before submitting their data, informed consent was provided by each participant, and by the end of the experiment they were carefully debriefed about the goals, intentions and scope of this project. They were also given the right to withdraw their data at any given time.

Figure 1: Stimuli from the second part of the experiment, divided into low, medium, and high differentiation. In the central column are the letter form that were studied. They were embedded in non-sense pronounceable words. All stimuli were digitally drawn and rendered in black over a white background, in raster images of 2352 x 968 pixels in size.

The second phase of the experiment was designed to measure differences between the perception of familiar handwritten letterforms against unfamiliar ones. This was achieved via an online survey, adapted to each participant based on the letterforms they used. In order to decide on which letterforms to use in the study, as these would need to cover the handwriting patterns of all participants, six experienced practitioners from Typotheque's team were asked to create pairs of letterforms in three levels: low difference, medium difference and high difference, based on a collection of international primary school writing models, previously compiled. The lists of hundreds of pairs produced by each practitioner were combined to find agreement. The four most agreed-upon pairs of letterforms from each level were selected and used for the study. They can be seen in Figure 1.

After participants submitted their handwriting specimens, these were scanned and analysed manually. For each subject, three letterforms that were consistently repeated in their specimen were identified — one from each differentiation level.

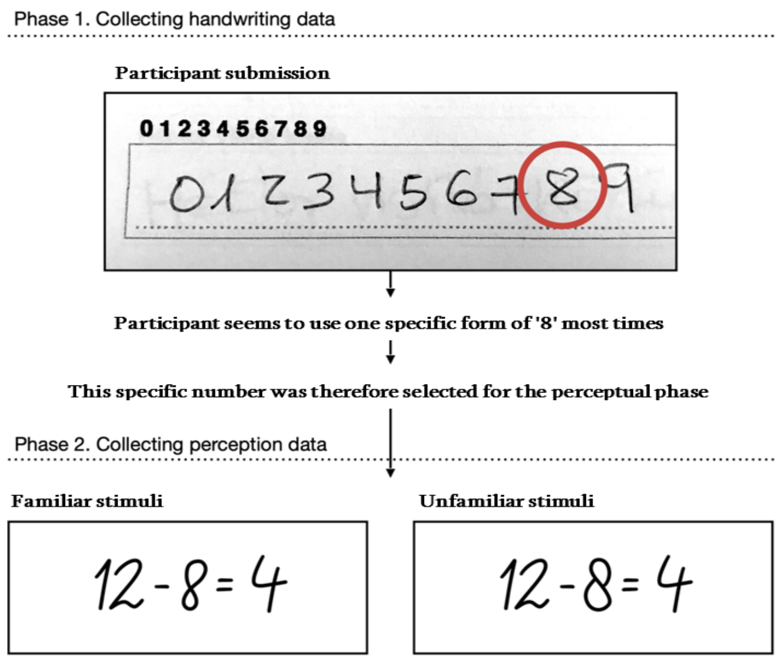


Figure 2: Example depicting the procedure used in the two phases of the experiment, where participants first provided their handwriting and later on, based on their input, the second survey was adapted to their own handwriting.

This way, each participant would be prompted to react to a pair of letters that had low, medium, and high differentiation, respectively, as against their personal handwriting style.

These handwritten statements were then consecutively rated by the participant using a scale for each of the five aforementioned judgment dimensions. The dimensions were measured implicitly, as the pilot, which followed the same experimental design, showed that participants could not identify the aims of the experiment.

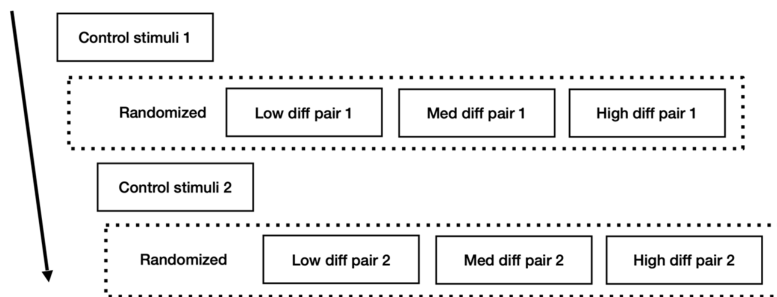


Figure 3: Partial randomisation sequence of the second part of the experiment. The two control stimuli were shown in fixed positions: at the start and midpoint of the experiment. The three pairs of letters that each participant evaluated were divided into two, and then randomised. This was so that pairs wouldn't be evaluated back-to-back, to remove likelihood of comparison.

No participant ever alluded to the anatomical change of the letters, and five out of the 30 asked if they had been shown the same letters multiple times. In addition, in the follow-up pilot questions that dealt with complexity, 12 participants reported that they found it hard and very hard to complete the ratings, as they seemed subjective. To achieve this effect, the display of questions was partially randomised using the order of presentation shown in Figure 3, with no two letters from a pair being shown consecutively. The initial reasoning of the experiment given to participants was that the study aimed to collect general opinions about handwritten text. After completing the experiment, participants were debriefed and given more details about the intention of the research.

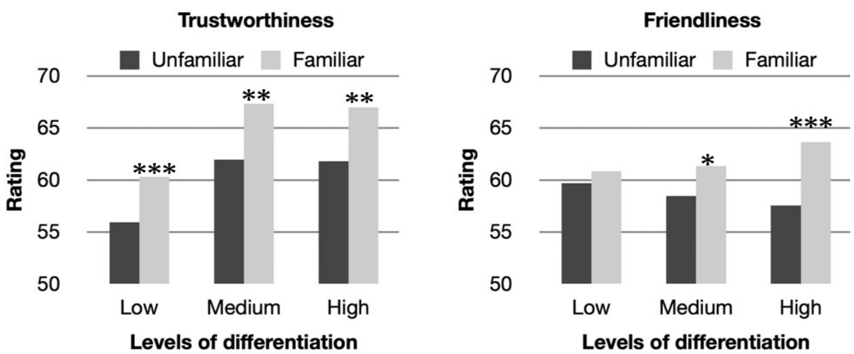
2.4 Participants

In total, 596 people provided their handwriting. Out of these, 479 responses were collected for the second part of the experiment. After removing incomplete and very brief responses, a total of 422 data points were used in the analysis. Participants had an average age of 27.4 years and were almost balanced in gender.

2.5 Analysis

Pre-processing included adjustment of ratings with the two control stimuli and removal of incomplete data points. Adjustment was made by subtracting ratings relating to the control in the middle of the experiment from those of the initial control and adding these to all ratings measured after the midpoint of the experiment (Ratings after midpoint + [Control 2 - Control 1]). The data was then transferred to statistics software for analysis. Five repeated measures ANOVAs were used to check the three hypotheses: Three for the differences between familiar and unfamiliar shapes for each hypothesis and two to evaluate the difference between gaps in trustworthiness and friendliness ratings. A sixth 3 Ч 5 repeated measures ANOVA was used to evaluate the influence of readability on the other factors. All data was shown to be normally distributed using Shapiro-Wilk.

Figure 4: Graphs showing average ratings for familiar versus unfamiliar letterforms across the three



levels of differentiation studied, for the trustworthiness and friendliness axes. A larger gap between familiar and unfamiliar conditions can be observed as differentiation increases on the friendliness axis. Asterisks represent p value results from the two 3 Ч 2 repeated-measures ANOVAs between Familiar and Unfamiliar averages. Three asterisks represent $p < .001$ and one $p < .05$.

3. Results

Analysis of the rating results aimed to test the first of two hypotheses revealed notable differences between familiar and unfamiliar shapes, as well as variations in perceived levels of trustworthiness and friendliness across levels of differentiation (see Figure 4). The ratings between familiar and unfamiliar letters increased as the pairs became more differentiated in shape (between Low, Medium, and High differentiation) for friendliness ratings. The first 3 Ч 2 repeated measures ANOVA looked at trustworthiness ratings. The main effect between levels of differentiation was found to be significant $F(2, 840) = 37.402$, $p <. 001$, as well as for between familiar and unfamiliar letterforms $F(1, 420) = 45.488$, $p < .001$.

Table 1: Results from ANOVA study on trustworthiness ratings

Trustworthiness ratings		Mean diff	SE	t	p
Low, familiar	Med, familiar	0.15	1.16	0.13	1.00
	High, familiar	5.99	1.16	5.17	**<.001**
	Low, unfamiliar	-5.40	1.17	-4.62	**<.001**
	Med, unfamiliar	-5.04	1.22	-4.15	**<.001**
	High, unfamiliar	1.62	1.22	1.33	0.731
Med, familiar	High, familiar	5.83	1.16	5.04	**<.001**
	Low, unfamiliar	-5.56	1.22	-4.57	**<.001**
	Med, unfamiliar	-5.19	1.17	-4.44	**<.001**
	High, unfamiliar	1.47	1.22	1.21	0.731
High, familiar	Low, unfamiliar	-11.40	1.22	-9.37	**<.001**
	Med, unfamiliar	-11.03	1.22	-9.07	**<.001**
	High, unfamiliar	-4.37	1.17	-3.73	**<.001**
Low, unfamiliar	Med, unfamiliar	0.36	1.16	-0.31	1.00
	High, unfamiliar	7.02	1.16	6.07	**<.001**
Med, unfamiliar	High, unfamiliar	6.66	1.16	5.75	**<.001**

Note. R Note. Results from the repeated measures ANOVA performed on trustworthiness ratings. "Low," "Med" and "High" represent levels of differentiation between familiar and unfamiliar stimuli. The three levels of differentiation showed a difference between conditions, with higher ratings for familiar shapes. Highlighted in bold are all significant p values.

The interaction between both was found to be non-significant $F(2, 840) = 0.245$, $p = 0.783$. Post-hoc results showed effects for Low differentiation $F(2, 420) = 4.623$, $p < .001$, Medium differentiation $F(2, 420) = 4.441$, $p < .001$; and High differentiation, $F(2, 420) = 3.734$, $p < .001$. Bonferroni correction was used for multiple comparisons. These findings show a difference in trustworthiness ratings across all levels of differentiation between familiar and unfamiliar conditions. Significant results from this ANOVA are shown as asterisks in Figure 4. For a comprehensive breakdown of these results, please refer to Table 1.

The second 3 Ч 2 repeated measures ANOVA compared friendliness ratings. The main effects between levels of differentiation were not significant $F(2, 840) = 0.446$, $p = 0.640$. Between conditions, a significant main effect was found $F(1, 420) = 20.773$, $p < .001$, and the interaction between factors was also found to be significant $F(2, 420) = 7.713$, $p < .001$. Post-hoc tests showed a non-significant difference was found with Low differentiation, F(2, 420) = 1.114, p = 0.860, a significant difference was found for Medium differentiation, F(2, 420) = 2.752, p = 0.050, as well as for High differentiation, F(2, 420) = 5.829, p < .001. Bonferroni adjusted for multiple comparisons. These findings show a difference in friendliness ratings only in the higher levels of differentiation between familiar and unfamiliar conditions. Significant results from this ANOVA are shown as asterisks in Figure 4. For a comprehensive breakdown of these findings, please refer to Table 2.

Readability ratings were compared against trustworthiness and friendliness using another 3 Ч 2 repeated measures ANOVA. The main effect wasn't significant between levels of differentiation F(2, 840) = 2.042, p = 0.430 nor between conditions F(1, 420) = 5.032, p = 0.634. The interaction between them was also non-significant F(2, 840) = 6.537, p = 0.061. Post-hoc analysis was performed. The effect was not statistically significant for Low, F(2, 240) = 3.576, p = 0.524; Medium, F(2, 240) = 3.923, p = 0.306 nor High differentiation, F(2, 240) = 0.402, p = 0.557.

Table 2: Results from ANOVA study on friendliness ratings

Friendliness ratings		**Mean diff**	**SE**	**t**	**p**
Low, familiar	Med, familiar	1.20	0.98	1.24	0.868
	High, familiar	2.12	0.98	2.18	0.208
	Low, unfamiliar	1.16	1.05	1.11	0.868
	Med, unfamiliar	1.67	1.11	1.51	0.661
	High, unfamiliar	3.98	1.11	3.59	0.004
Med, familiar	High, familiar	0.92	0.97	0.94	0.868
	Low, unfamiliar	2.36	1.11	2.13	0.208
	Med, unfamiliar	-2.87	1.05	2.75	**0.050**
	High, unfamiliar	5.18	1.11	4.68	**<.001**
High, familiar	Low, unfamiliar	3.28	1.11	2.96	0.034
	Med, unfamiliar	3.79	1.11	3.42	0.008
	High, unfamiliar	6.10	1.05	5.83	**<.001**
Low, unfamiliar	Med, unfamiliar	0.51	0.98	0.52	0.868
	High, unfamiliar	2.81	0.98	2.89	0.039
Med, unfamiliar	High, unfamiliar	2.31	0.98	2.37	0.144

Note. Results from the repeated measures ANOVA performed on friendliness ratings. "Low," "Med" and "High" represent levels of differentiation between familiar and unfamiliar stimuli. The three levels of differentiation showed a difference between conditions, with higher ratings for familiar shapes. Highlighted in bold are all significant p values.

To answer the third of the hypotheses initially posed, the age of the participant was subtracted from all of their perceived age ratings, and these differences were compared between familiar and unfamiliar shapes using another 3 Ч 2 repeated measures ANOVA. No main effects were found to be significant for levels of differentiation F(2, 840) = 1.150, p = 1.000, conditions F(1, 420) = 0.133 p = 0.823 nor the interaction between them F(2, 840) = 1.421, p = 0.914. Post-hoc tests showed no differences were statistically significant for Low differentiation, F(2, 240) = 0.012, p = 0.523; Medium, F(2, 240) = 0.029, p = 0.689; and High, F(2, 240) = 0.230, p = 0.638. For gender, the same analysis was performed, with no significant results for levels of differentiation F(2, 840) = 5.235, p = 0.963, conditions F(1, 420) = 2.041, p = 1.000 nor the interaction between them F(2, 840) = 0.345, p = 0.562. Post-hoc analysis showed no differences across levels of differentiation either. For Low differentiation, F(2, 240) = 0.014, p = 0.255; for Medium, F(2, 240) = 0.006, p = 0.650 and for High differentiation, F(2, 240) = 0.104, p = 0.187.

4. Discussion

This paper has investigated the effect of familiarity on the perception of handwriting. Our results arrived at from examining the data gained from the 422 participants found support for our first two hypotheses, showing that familiarity with handwritten letterforms influences perceived trustworthiness and friendliness. In other words, participants tended to assign letter shapes that resembled their own handwriting style as having positive connotations compared to letter shapes that were more different from their own writing style. Our findings align with previous studies, demonstrating that participants assign semantic association to letter styles (Brumberger, 2003; Hazlett et al., 2013; Valasco et al., 2015; Schroll et al., 2018) and that familiar stimuli are preferred over unfamiliar ones (Sheldon, 1969; Zizak & Reber, 2004; Ashcraft, 2006) demonstrating that the mere-exposure, positively correlates with other implicit judgments. The available research was examined with a view to applying it to typography; in particular, the work published by Beier and Larson (2013) suggests that familiarity has an impact on preference. Hence, this research posited that such bias could also emerge in relation to handwriting, with subjects potentially rating familiar handwritten letterforms as more trustworthy and friendly.

As the difference between one's own handwriting and alien handwriting became greater, so did the gap between bias in the case of friendliness. The further the style of a letter seems to depart from one's own handwriting, the greater this effect will be (see Figure 4). This indicates that people are in fact affected by the extent to which they personally identify with a style of text when it comes to perceived friendliness, a finding that aligns with previous work showing that these biases appear even implicitly (Devos & Banaji, 2006).

The factor of readability was also explored, and for the purpose of this study this was addressed through perceived readability measures. Literature had suggested an interaction between reading performance and familiarity (Beier & Larson, 2013), and this relationship was expected to correlate somewhat with friendliness and trustworthiness ratings. However, this proved not to be the case; as familiarity did not predict perceived readability, nor did perceived readability interact with any of the other dependent variables studied.

A third hypothesis predicted that participants would project their age and gender onto letterforms they used, or at least comparatively more so than with those they did not use. Previous research had shown that familiarity breeds empathy (Motomura et al., 2015; Beckes et al., 2012; Abramson, 2021), which is a predictor for projection (Epley et al., 2007). The data collected in this research, though, cannot be used to reject the null hypothesis posed. A statistical difference in the age gap and gender coherence between reader and text could not be measured.

For the selection of the letterform pairs, and their division into three groups based on their level of differentiation, we used criteria compiled by a team of experienced type designers. The selection correctly reflected the bias increase regarding friendliness. This can be taken as an indicator of intuitive expertise, common among practitioners in this field. Most of the knowledge we have today about type is built on years of practical tuning and the intuition of several generations of practitioners. More recently, formal research has shown empirically that the intuition of those working in type is largely accurate (e.g. familiarity of shapes being a predictor of legibility; Beier, 2009; Beier and Larson, 2013), and this aspect of the study can be considered further proof of that. Trustworthiness ratings might have not reflected this because of how much more abstract this construct is in comparison to friendliness, especially when being asked to map it to inanimate texts.

4.1 Limitations and future research

Although evidence was found to support the proposition that individuals carry their own personal attitude towards certain shapes in handwriting, these attitudes may have been elicited by how the survey was framed. The judgments studied were measured implicitly, as participants were unconsciously and systematically rating familiar and unfamiliar shapes differently, but this does not test the pervasiveness of this difference. It could be that an average reader, when being exposed to handwriting, will find a bias so small that it does not affect their perception of the text whatsoever. It is true, though, that laypeople often hold opinions when it comes to handwritten text, but whether familiarity could be accounted for as a driver of these opinions should be studied further. Additionally, familiarity was measured assuming personal handwriting served as a good predictor for familiar text. It may be positive to evaluate other tangential measurements of familiarity.

Lastly, the data discussed in this manuscript could have been analysed in different ways, and further evaluation could potentially identify patterns and correlations that are not observed in this study. Demographic data, for example, was not taken into consideration for the purposes of this paper. Regional differences, as well as age, education, and even gender, might have an effect on the bias that was measured. The data collected, though, which comprises a large number of handwriting specimens and plenty of perceptual information about handwritten text, represents a novel asset in the field of handwriting research. All of it is now publicly available, both as an associated online database containing all handwriting specimens and upon request by contacting the researchers of this piece.

5. Conclusion

In conclusion, our study indicates that familiarity with handwritten letterforms influences perceived trustworthiness and friendliness. Participants tended to view letter shapes resembling their own handwriting style more positively compared to dissimilar ones. Building upon existing literature, our study suggests that familiarity plays a significant role in shaping preferences, extending this understanding to handwritten text and highlighting the implicit bias individuals may have towards text resembling their own handwriting style.

Author notes, motivations, and interests

This study was funded by Typotheque B V. (The Hague, Netherlands) a design studio that specialises in typographic design. The motivation behind this research was to gather new knowledge for the production of new commercial script typefaces, that is, digital fonts that resemble handwriting. This experiment is part of this larger research effort, which includes other commercially funded studies. Some have been made public, like Typotheque's Handwriting Database. Others answer questions that are of interest only internally, and solely served the purpose of designing aforementioned new typefaces. The present paper covers the research questions from this larger investigation that may be of interest to the academic fields of writing research and social psychology. There was an inherent interest on the part of Typotheque in sharing this knowledge from the outset of this research.

The main author of this piece, Hйctor Mangas Afonso, is affiliated with Typotheque. He carries out work as a researcher for the company. From an early stage in this research, he received supervision from Dr Anouk Keizer (University of Utrecht, Netherlands), who helped assess the quality of the research as it unfolded. She also aided in the writing of this paper, for which she is credited as a co-author. This collaboration was unpaid, and her involvement was voluntary. Peter Bi□ak, founder of Typotheque, is also credited as a co-author. He worked on the design of the study and provided feedback during the writing of this paper.

Dr Sofie Beier (Centre for Visibility Design, Royal Danish Academy of Fine Arts, Denmark), aided in the writing this manuscript, for which she is credited as a co-author. This collaboration was unpaid and her involvement was voluntary.

All the data generated during this study (the ratings from participants used in the analysis of this manuscript, but also all handwritten samples and anonymised metadata

about participants) is available upon request. Please contact hector@typotheque.com to ask for a package with all data.

Ethical Approval

The Committee of Ethics of the University of Utrecht (Netherlands) provided approval on the research retroactively during 2023.

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