

The Supplemental Material for "Attribute2Font: Creating Fonts You Want From Attributes"

YIZHI WANG*, Wangxuan Institute of Computer Technology, Peking University, China

YUE GAO*, Wangxuan Institute of Computer Technology, Peking University, China

ZHOHHUI LIAN[†], Wangxuan Institute of Computer Technology, Peking University, China

In this document, we provide additional experimental results in support of the conclusions drawn in the primary text. The figures to be presented and their corresponding subjects are listed as follows:

- Fig. 1 and Fig. 2 show how the pixel loss l_{pixel} (namely L1 loss) varies with the training steps and the validation steps. l_{pixel} is an important metric that evaluates our model's performance of accurately reconstructing the target glyphs (lower is better). We calculate our model's L1 loss on the validation dataset every 400 training steps. We randomly select 28 fonts from the labeled fonts and match them for the 28 fonts in the validation dataset. All models in Fig. 2 use the same source fonts for fair comparison. We can see that the loss curve elevates dramatically with the removal of skip-connection from our model. Both the AAM and the VST boost our model's performance in a significant degree.
- Fig. 3: the effect of the choice of source font in the inference stage.
- Fig. 4: the impacts of different modules in our model.
- Fig. 5: generating Chinese fonts from attributes.
- Fig. 6, 7, 8 and 9: generating English and Chinese glyph images by interpolation between the attribute values of two different fonts.
- Fig. 10, 11, 12 and 13: editing English Chinese fonts by changing the value of a single attribute.
- Fig. 14 and 15: comparison of our model and existing methods of attribute-controllable image synthesis, including AttGAN [He et al. 2019], StarGAN [Choi et al. 2018], RelGAN [Wu et al. 2019] and STGAN [Liu et al. 2019].
- Fig. 16: comparison of our model and two existing font retrieval methods ([O'Donovan et al. 2014] and [Chen et al. 2019]).
- Fig. 17: the glyph images of a whole char-set generated by our method from random attribute values.
- Fig. 18: some continuous texts rendered by our model's generated fonts.

REFERENCES

- Tianlang Chen, Zhaowen Wang, Ning Xu, Hailin Jin, and Jiebo Luo. 2019. Large-scale Tag-based Font Retrieval with Generative Feature Learning. In *ICCV*. 9116–9125.
 Yunjey Choi, Minje Choi, Munyoung Kim, Jung-Woo Ha, Sungyun Kim, and Jaegul Choo. 2018. Stargan: Unified generative adversarial networks for multi-domain image-to-image translation. In *CVPR*. 8789–8797.

*Denotes equal contribution

[†]Corresponding author

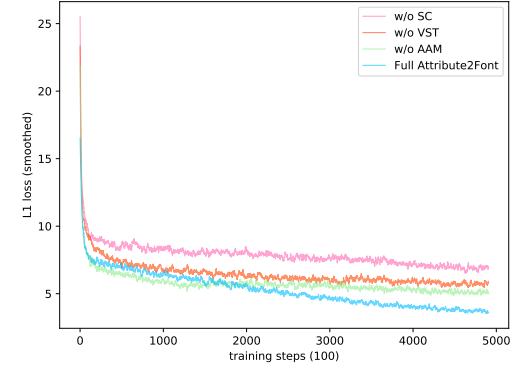


Fig. 1. The L1 losses of our models with different configurations in the training process.

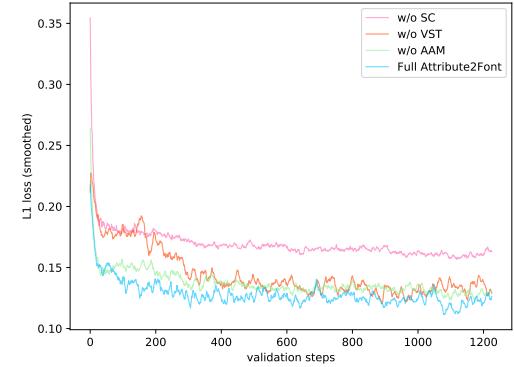


Fig. 2. The L1 losses of our models with different configurations in the validation process.

- Zhenliang He, Wangmeng Zuo, Meina Kan, Shiguang Shan, and Xilin Chen. 2019. Attgan: Facial attribute editing by only changing what you want. *IEEE Transactions on Image Processing* (2019).
 Ming Liu, Yukang Ding, Min Xia, Xiao Liu, Errui Ding, Wangmeng Zuo, and Shilei Wen. 2019. STGAN: A Unified Selective Transfer Network for Arbitrary Image Attribute Editing. In *CVPR*. 3673–3682.
 Peter O'Donovan, Jánis Libeks, Aseem Agarwala, and Aaron Hertzmann. 2014. Exploratory font selection using crowdsourced attributes. *ACM Transactions on Graphics (TOG)* 33, 4 (2014), 92.
 Po-Wei Wu, Yu-Jing Lin, Che-Han Chang, Edward Y Chang, and Shih-Wei Liao. 2019. Relgan: Multi-domain image-to-image translation via relative attributes. In *ICCV*. 5914–5922.



Fig. 3. Generating glyph images with the same target attribute values from different source fonts. The pixel value of each grayscale grid represents each attribute's value. A darker grid indicates a higher attribute value. In the following figures we use the same way to display attribute values.

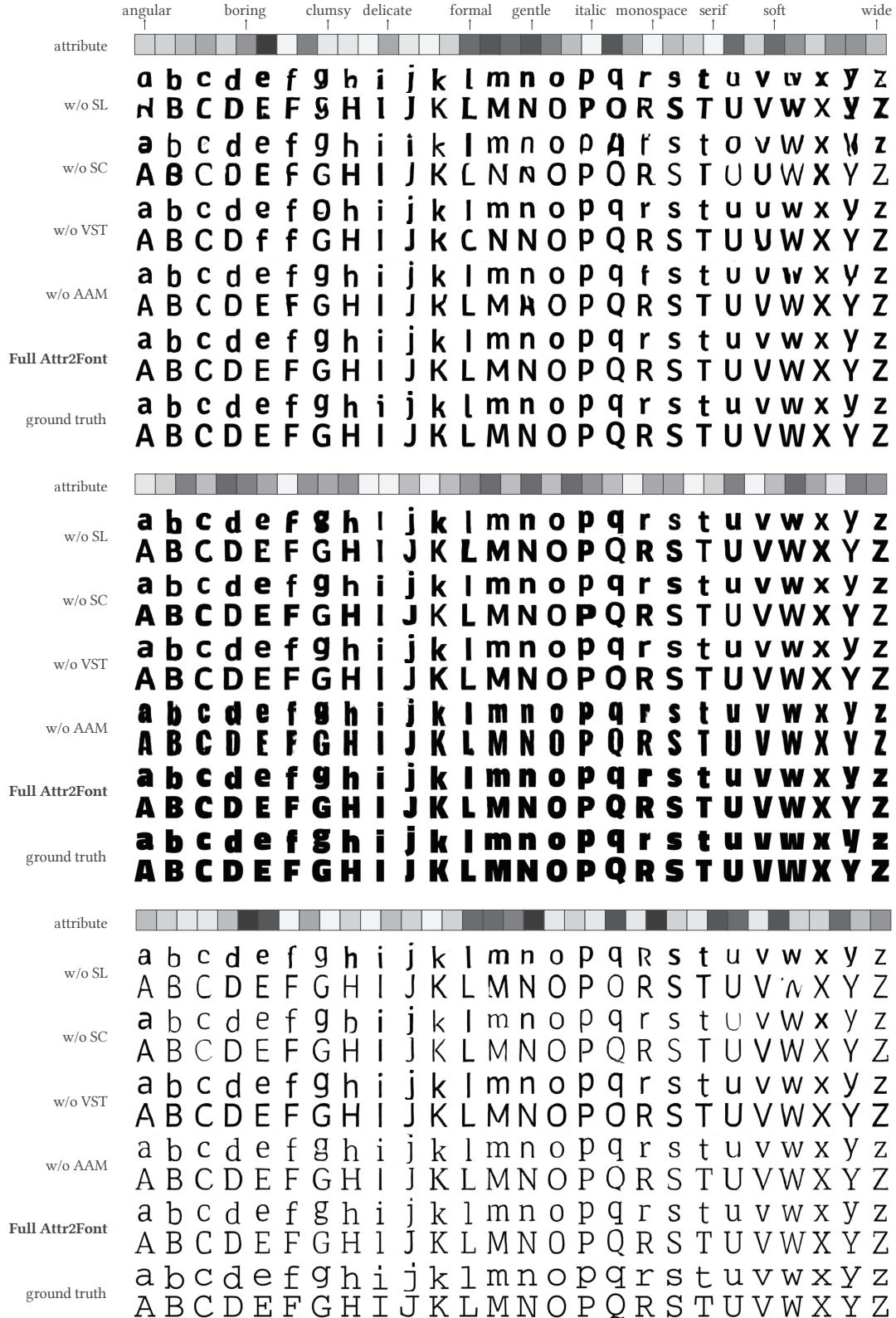


Fig. 4. The glyph images generated by our models with different configurations. w/o denotes without. "SL", "SC", "VST" and "AAM" denote semi-supervised learning, skip-connection, Visual Style Transformer and Attribute Attention Module, respectively.



Fig. 5. Generating Chinese fonts from attributes.

font 1	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
$\lambda = 0.0$	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
$\lambda = 0.1$	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
$\lambda = 0.2$	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
$\lambda = 0.3$	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
$\lambda = 0.4$	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
$\lambda = 0.5$	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
$\lambda = 0.6$	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
$\lambda = 0.7$	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
$\lambda = 0.8$	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
$\lambda = 0.9$	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
$\lambda = 1.0$	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
font 2	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
$\lambda = 0.0$	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
$\lambda = 0.1$	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
$\lambda = 0.2$	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
$\lambda = 0.3$	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
$\lambda = 0.4$	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
$\lambda = 0.5$	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
$\lambda = 0.6$	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
$\lambda = 0.7$	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
$\lambda = 0.8$	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
$\lambda = 0.9$	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
$\lambda = 1.0$	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
font 3	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
$\lambda = 0.0$	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
$\lambda = 0.1$	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
$\lambda = 0.2$	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
$\lambda = 0.3$	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
$\lambda = 0.4$	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
$\lambda = 0.5$	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
$\lambda = 0.6$	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
$\lambda = 0.7$	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
$\lambda = 0.8$	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
$\lambda = 0.9$	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
$\lambda = 1.0$	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
font 4	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Fig. 6. Generating English glyph images of upper cases by interpolation between the attribute values of two different fonts. Three interpolation processes (Font 1 to Font2, Font 2 to Font 3, Font 3 to Font 4) are presented in succession.

font 1	a b c d e f g h i j k l m n o p q r s t u v w x y z
$\lambda = 0.0$	a b c d e f g h i j k l m n o p q r s t u v w x y z
$\lambda = 0.1$	a b c d e f g h i j k l m n o p q r s t u v w x y z
$\lambda = 0.2$	a b c d e f g h i j k l m n o p q r s t u v w x y z
$\lambda = 0.3$	a b c d e f g h i j k l m n o p q r s t u v w x y z
$\lambda = 0.4$	a b c d e f g h i j k l m n o p q r s t u v w x y z
$\lambda = 0.5$	a b c d e f g h i j k l m n o p q r s t u v w x y z
$\lambda = 0.6$	a b c d e f g h i j k l m n o p q r s t u v w x y z
$\lambda = 0.7$	a b c d e f g h i j k l m n o p q r s t u v w x y z
$\lambda = 0.8$	a b c d e f g h i j k l m n o p q r s t u v w x y z
$\lambda = 0.9$	a b c d e f g h i j k l m n o p q r s t u v w x y z
$\lambda = 1.0$	a b c d e f g h i j k l m n o p q r s t u v w x y z
font 2	a b c d e f g h i j k l m n o p q r s t u v w x y z
$\lambda = 0.0$	a b c d e f g h i j k l m n o p q r s t u v w x y z
$\lambda = 0.1$	a b c d e f g h i j k l m n o p q r s t u v w x y z
$\lambda = 0.2$	a b c d e f g h i j k l m n o p q r s t u v w x y z
$\lambda = 0.3$	a b c d e f g h i j k l m n o p q r s t u v w x y z
$\lambda = 0.4$	a b c d e f g h i j k l m n o p q r s t u v w x y z
$\lambda = 0.5$	a b c d e f g h i j k l m n o p q r s t u v w x y z
$\lambda = 0.6$	a b c d e f g h i j k l m n o p q r s t u v w x y z
$\lambda = 0.7$	a b c d e f g h i j k l m n o p q r s t u v w x y z
$\lambda = 0.8$	a b c d e f g h i j k l m n o p q r s t u v w x y z
$\lambda = 0.9$	a b c d e f g h i j k l m n o p q r s t u v w x y z
$\lambda = 1.0$	a b c d e f g h i j k l m n o p q r s t u v w x y z
font 3	a b c d e f g h i j k l m n o p q r s t u v w x y z
$\lambda = 0.0$	a b c d e f g h i j k l m n o p q r s t u v w x y z
$\lambda = 0.1$	a b c d e f g h i j k l m n o p q r s t u v w x y z
$\lambda = 0.2$	a b c d e f g h i j k l m n o p q r s t u v w x y z
$\lambda = 0.3$	a b c d e f g h i j k l m n o p q r s t u v w x y z
$\lambda = 0.4$	a b c d e f g h i j k l m n o p q r s t u v w x y z
$\lambda = 0.5$	a b c d e f g h i j k l m n o p q r s t u v w x y z
$\lambda = 0.6$	a b c d e f g h i j k l m n o p q r s t u v w x y z
$\lambda = 0.7$	a b c d e f g h i j k l m n o p q r s t u v w x y z
$\lambda = 0.8$	a b c d e f g h i j k l m n o p q r s t u v w x y z
$\lambda = 0.9$	a b c d e f g h i j k l m n o p q r s t u v w x y z
$\lambda = 1.0$	a b c d e f g h i j k l m n o p q r s t u v w x y z
font 4	a b c d e f g h i j k l m n o p q r s t u v w x y z

Fig. 7. Generating English glyph images of lower cases by interpolation between the attribute values of two different fonts. Three interpolation processes (Font 1 to Font2, Font 2 to Font 3, Font 3 to Font 4) are presented in succession.

Fig. 8. Generating Chinese glyph images by interpolation between the attribute values of two different fonts (Part 1). Three interpolation processes (Font 1 to Font2, Font 3 to Font 4, Font 5 to Font 6) are presented in succession.

font 7 爱凹教奥扒八爸白拜帮雹卑市甬比必辟臂变卞彪斌濒秉博勃
 $\lambda = 0.0$ 爱凹教奥扒八爸白拜帮雹卑本甬比必辟臂变卞彪斌濒秉博勃
 $\lambda = 0.1$ 爱凹教奥扒八爸白拜帮雹卑本甬比必辟臂变卞彪斌濒秉博勃
 $\lambda = 0.2$ 爱凹教奥扒八爸白拜帮雹卑本甬比必辟臂变卞彪斌濒秉博勃
 $\lambda = 0.3$ 爱凹教奥扒八爸白拜帮雹卑本甬比必辟臂变卞彪斌濒秉博勃
 $\lambda = 0.4$ 爱凹教奥扒八爸白拜帮雹卑本甬比必辟臂变卞彪斌濒秉博勃
 $\lambda = 0.5$ 爱凹教奥扒八爸白拜帮雹卑本甬比必辟臂变卞彪斌濒秉博勃
 $\lambda = 0.6$ 爱凹教奥扒八爸白拜帮雹卑本甬比必辟臂变卞彪斌濒秉博勃
 $\lambda = 0.7$ 爱凹教奥扒八爸白拜帮雹卑本甬比必辟臂变卞彪斌濒秉博勃
 $\lambda = 0.8$ 爱凹教奥扒八爸白拜帮雹卑本甬比必辟臂变卞彪斌濒秉博勃
 $\lambda = 0.9$ 爱凹教奥扒八爸白拜帮雹卑本甬比必辟臂变卞彪斌濒秉博勃
 $\lambda = 1.0$ 爱凹教奥扒八爸白拜帮雹卑本甬比必辟臂变卞彪斌濒秉博勃
 font 8 爱凹教奥扒八爸白拜帮雹卑本甬比必辟臂变卞彪斌濒秉博勃

 font 9 爱凹教奥扒八爸白拜帮雹卑本甬比必辟臂变卞彪斌濒秉博勃
 $\lambda = 0.0$ 爱凹教奥扒八爸白拜帮雹卑本甬比必辟臂变卞彪斌濒秉博勃
 $\lambda = 0.1$ 爱凹教奥扒八爸白拜帮雹卑本甬比必辟臂变卞彪斌濒秉博勃
 $\lambda = 0.2$ 爱凹教奥扒八爸白拜帮雹卑本甬比必辟臂变卞彪斌濒秉博勃
 $\lambda = 0.3$ 爱凹教奥扒八爸白拜帮雹卑本甬比必辟臂变卞彪斌濒秉博勃
 $\lambda = 0.4$ 爱凹教奥扒八爸白拜帮雹卑本甬比必辟臂变卞彪斌濒秉博勃
 $\lambda = 0.5$ 爱凹教奥扒八爸白拜帮雹卑本甬比必辟臂变卞彪斌濒秉博勃
 $\lambda = 0.6$ 爱凹教奥扒八爸白拜帮雹卑本甬比必辟臂变卞彪斌濒秉博勃
 $\lambda = 0.7$ 爱凹教奥扒八爸白拜帮雹卑本甬比必辟臂变卞彪斌濒秉博勃
 $\lambda = 0.8$ 爱凹教奥扒八爸白拜帮雹卑本甬比必辟臂变卞彪斌濒秉博勃
 $\lambda = 0.9$ 爱凹教奥扒八爸白拜帮雹卑本甬比必辟臂变卞彪斌濒秉博勃
 $\lambda = 1.0$ 爱凹教奥扒八爸白拜帮雹卑本甬比必辟臂变卞彪斌濒秉博勃
 font 10 爱凹教奥扒八爸白拜帮雹卑本甬比必辟臂变卞彪斌濒秉博勃

 font 11 弟电刁丁鼎定东兜斗段断顿而儿二貳发乏返泛方飞丰弗甫斧
 $\lambda = 0.0$ 弟电刁丁鼎定东兜斗段断顿而儿二貳发乏返泛方飞丰弗甫斧
 $\lambda = 0.1$ 弟电刁丁鼎定东兜斗段断顿而儿二貳发乏返泛方飞丰弗甫斧
 $\lambda = 0.2$ 弟电刁丁鼎定东兜斗段断顿而儿二貳发乏返泛方飞丰弗甫斧
 $\lambda = 0.3$ 弟电刁丁鼎定东兜斗段断顿而儿二貳发乏返泛方飞丰弗甫斧
 $\lambda = 0.4$ 弟电刁丁鼎定东兜斗段断顿而儿二貳发乏返泛方飞丰弗甫斧
 $\lambda = 0.5$ 弟电刁丁鼎定东兜斗段断顿而儿二貳发乏返泛方飞丰弗甫斧
 $\lambda = 0.6$ 弟电刁丁鼎定东兜斗段断顿而儿二貳发乏返泛方飞丰弗甫斧
 $\lambda = 0.7$ 弟电刁丁鼎定东兜斗段断顿而儿二貳发乏返泛方飞丰弗甫斧
 $\lambda = 0.8$ 弟电刁丁鼎定东兜斗段断顿而儿二貳发乏返泛方飞丰弗甫斧
 $\lambda = 0.9$ 弟电刁丁鼎定东兜斗段断顿而儿二貳发乏返泛方飞丰弗甫斧
 $\lambda = 1.0$ 弟电刁丁鼎定东兜斗段断顿而儿二貳发乏返泛方飞丰弗甫斧
 font 12 弟电刁丁鼎定东兜斗段断顿而儿二貳发乏返泛方飞丰弗甫斧

Fig. 9. Generating Chinese glyph images by interpolation between the attribute values of two different fonts (Part 2). Three interpolation processes (Font 7 to Font 8, Font 9 to Font 10, Font 11 to Font 12) are presented in succession.

	strong																									
source font	a	b	c	d	e	f	g	h	i	j	k		m	n	o	p	q	r	s	t	u	v	w	x	y	z
$v = 0.0$	a	b	c	d	e	f	g	h	i	j	k		m	n	o	p	q	r	s	t	u	v	w	x	y	z
$v = 0.1$	a	b	c	d	e	f	g	h	i	j	k		m	n	o	p	q	r	s	t	u	v	w	x	y	z
$v = 0.2$	a	b	c	d	e	f	g	h	i	j	k		m	n	o	p	q	r	s	t	u	v	w	x	y	z
$v = 0.3$	a	b	c	d	e	f	g	h	i	j	k		m	n	o	p	q	r	s	t	u	v	w	x	y	z
$v = 0.4$	a	b	c	d	e	f	g	h	i	j	k		m	n	o	p	q	r	s	t	u	v	w	x	y	z
$v = 0.5$	a	b	c	d	e	f	g	h	i	j	k		m	n	o	p	q	r	s	t	u	v	w	x	y	z
$v = 0.6$	a	b	c	d	e	f	g	h	i	j	k		m	n	o	p	q	r	s	t	u	v	w	x	y	z
$v = 0.7$	a	b	c	d	e	f	g	h	i	j	k		m	n	o	p	q	r	s	t	u	v	w	x	y	z
$v = 0.8$	a	b	c	d	e	f	g	h	i	j	k		m	n	o	p	q	r	s	t	u	v	w	x	y	z
$v = 0.9$	a	b	c	d	e	f	g	h	i	j	k		m	n	o	p	q	r	s	t	u	v	w	x	y	z
$v = 1.0$	a	b	c	d	e	f	g	h	i	j	k		m	n	o	p	q	r	s	t	u	v	w	x	y	z
	serif																									
source font	a	b	c	d	e	f	g	h	i	j	k		m	n	o	p	q	r	s	t	u	v	w	x	y	z
$v = 0.0$	a	b	c	d	e	f	g	h	i	j	k		m	n	o	p	q	r	s	t	u	v	w	x	y	z
$v = 0.1$	a	b	c	d	e	f	g	h	i	j	k		m	n	o	p	q	r	s	t	u	v	w	x	y	z
$v = 0.2$	a	b	c	d	e	f	g	h	i	j	k		m	n	o	p	q	r	s	t	u	v	w	x	y	z
$v = 0.3$	a	b	c	d	e	f	g	h	i	j	k		m	n	o	p	q	r	s	t	u	v	w	x	y	z
$v = 0.4$	a	b	c	d	e	f	g	h	i	j	k		m	n	o	p	q	r	s	t	u	v	w	x	y	z
$v = 0.5$	a	b	c	d	e	f	g	h	i	j	k		m	n	o	p	q	r	s	t	u	v	w	x	y	z
$v = 0.6$	a	b	c	d	e	f	g	h	i	j	k		m	n	o	p	q	r	s	t	u	v	w	x	y	z
$v = 0.7$	a	b	c	d	e	f	g	h	i	j	k		m	n	o	p	q	r	s	t	u	v	w	x	y	z
$v = 0.8$	a	b	c	d	e	f	g	h	i	j	k		m	n	o	p	q	r	s	t	u	v	w	x	y	z
$v = 0.9$	a	b	c	d	e	f	g	h	i	j	k		m	n	o	p	q	r	s	t	u	v	w	x	y	z
$v = 1.0$	a	b	c	d	e	f	g	h	i	j	k		m	n	o	p	q	r	s	t	u	v	w	x	y	z
	italic																									
source font	a	b	c	d	e	f	g	h	i	j	k		m	n	o	p	q	r	s	t	u	v	w	x	y	z
$v = 0.0$	a	b	c	d	e	f	g	h	i	j	k		m	n	o	p	q	r	s	t	u	v	w	x	y	z
$v = 0.1$	a	b	c	d	e	f	g	h	i	j	k		m	n	o	p	q	r	s	t	u	v	w	x	y	z
$v = 0.2$	a	b	c	d	e	f	g	h	i	j	k		m	n	o	p	q	r	s	t	u	v	w	x	y	z
$v = 0.3$	a	b	c	d	e	f	g	h	i	j	k		m	n	o	p	q	r	s	t	u	v	w	x	y	z
$v = 0.4$	a	b	c	d	e	f	g	h	i	j	k		m	n	o	p	q	r	s	t	u	v	w	x	y	z
$v = 0.5$	a	b	c	d	e	f	g	h	i	j	k		m	n	o	p	q	r	s	t	u	v	w	x	y	z
$v = 0.6$	a	b	c	d	e	f	g	h	i	j	k		m	n	o	p	q	r	s	t	u	v	w	x	y	z
$v = 0.7$	a	b	c	d	e	f	g	h	i	j	k		m	n	o	p	q	r	s	t	u	v	w	x	y	z
$v = 0.8$	a	b	c	d	e	f	g	h	i	j	k		m	n	o	p	q	r	s	t	u	v	w	x	y	z
$v = 0.9$	a	b	c	d	e	f	g	h	i	j	k		m	n	o	p	q	r	s	t	u	v	w	x	y	z
$v = 1.0$	a	b	c	d	e	f	g	h	i	j	k		m	n	o	p	q	r	s	t	u	v	w	x	y	z

Fig. 10. Editing English fonts by changing the value of a single attribute (Part 1).

		cursive
source font	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	
v = 0.0	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	
v = 0.1	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	
v = 0.2	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	
v = 0.3	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	
v = 0.4	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	
v = 0.5	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	
v = 0.6	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	
v = 0.7	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	
v = 0.8	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	
v = 0.9	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	
v = 1.0	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	
		display
source font	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	
v = 0.0	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	
v = 0.1	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	
v = 0.2	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	
v = 0.3	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	
v = 0.4	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	
v = 0.5	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	
v = 0.6	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	
v = 0.7	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	
v = 0.8	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	
v = 0.9	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	
v = 1.0	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	
		wide
source font	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	
v = 0.0	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	
v = 0.1	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	
v = 0.2	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	
v = 0.3	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	
v = 0.4	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	
v = 0.5	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	
v = 0.6	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	
v = 0.7	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	
v = 0.8	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	
v = 0.9	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	
v = 1.0	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	

Fig. 11. Editing English fonts by changing the value of a single attribute (Part 2).

Fig. 12. Editing Chinese fonts by changing the value of a single attribute (Part 1).

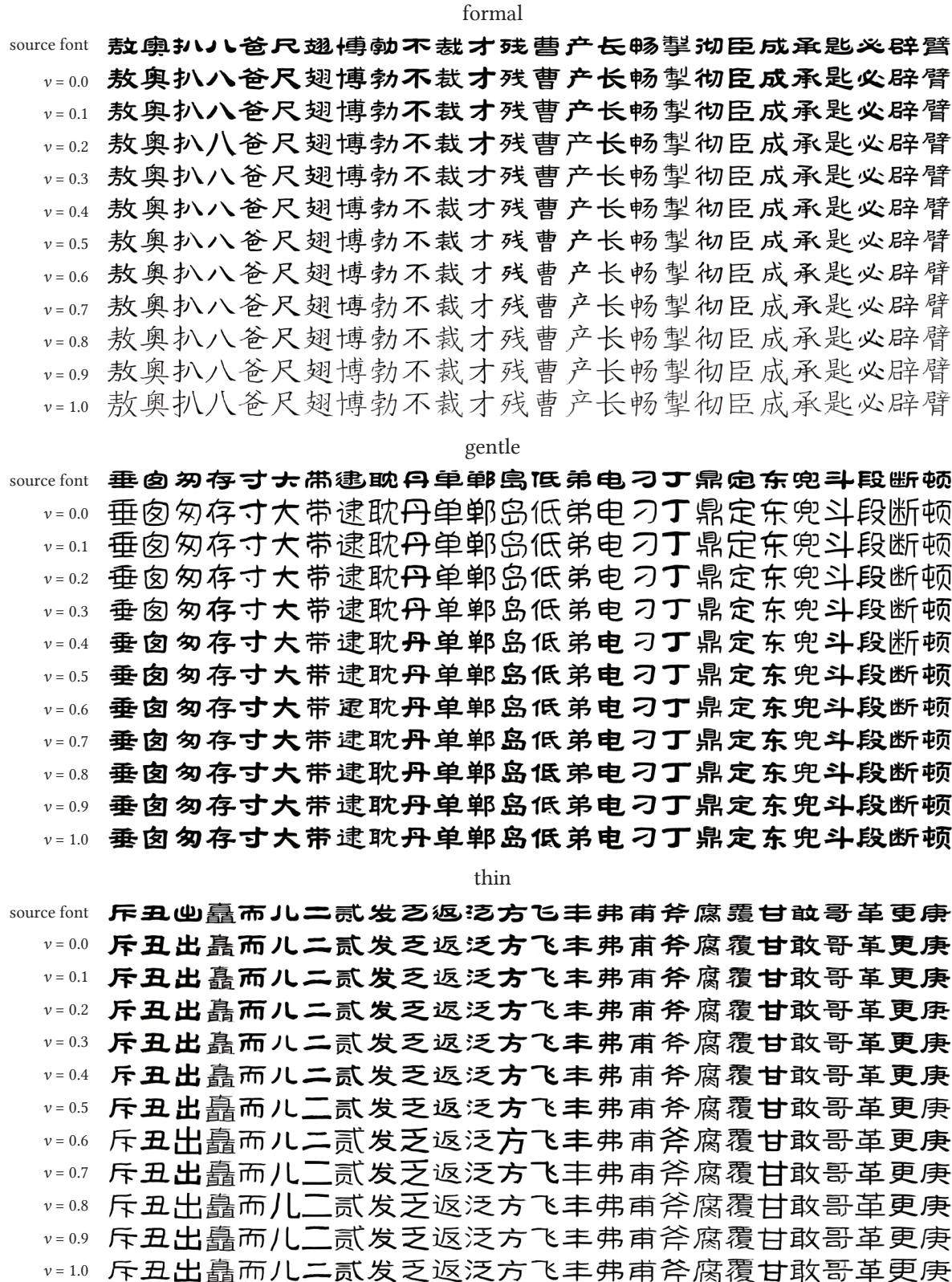


Fig. 13. Editing Chinese fonts by changing the value of a single attribute (Part 2).



Fig. 14. Comparison with existing methods of attribute-controllable image synthesis (Part 1).

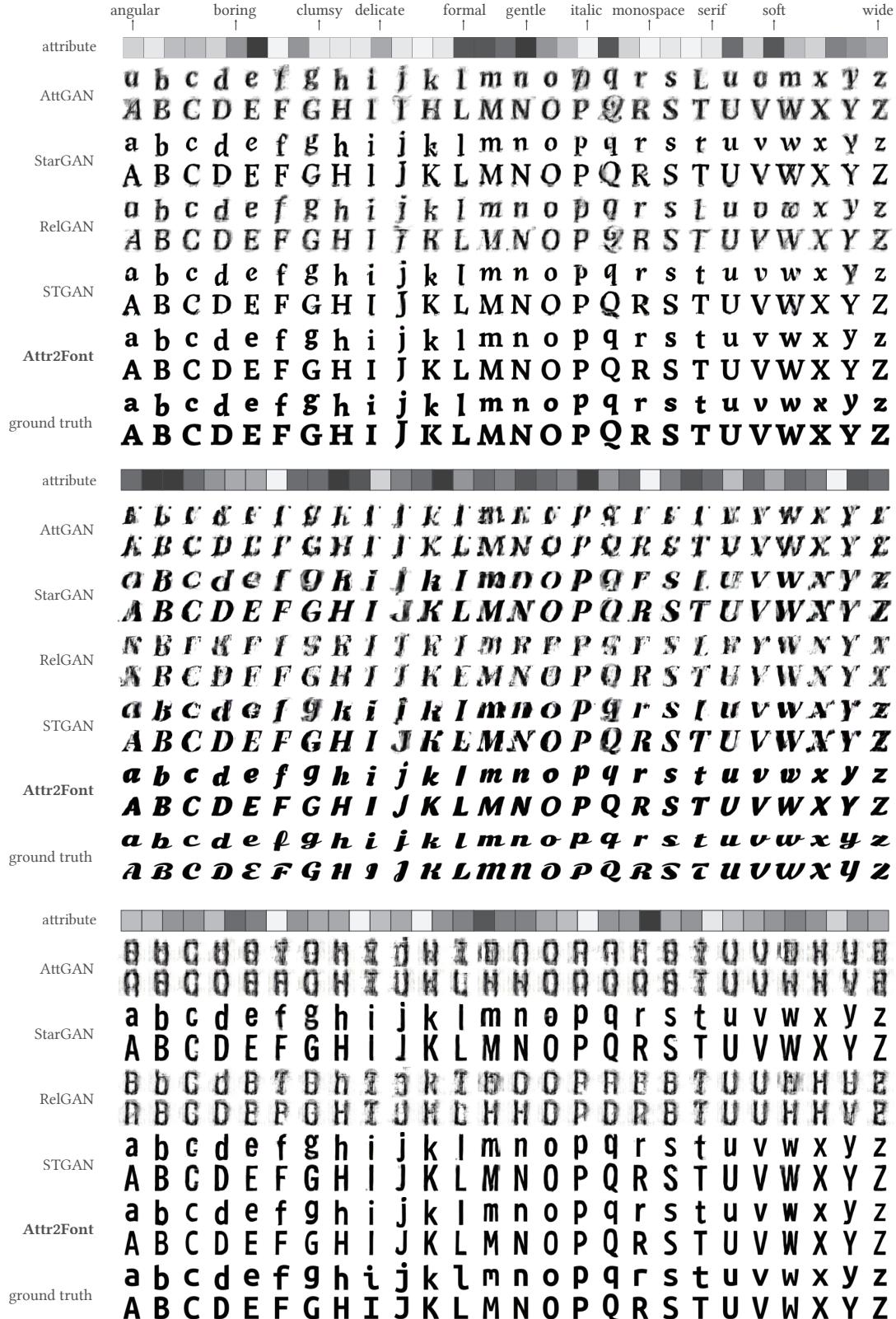


Fig. 15. Comparison with existing methods of attribute-controllable image synthesis (Part 2).

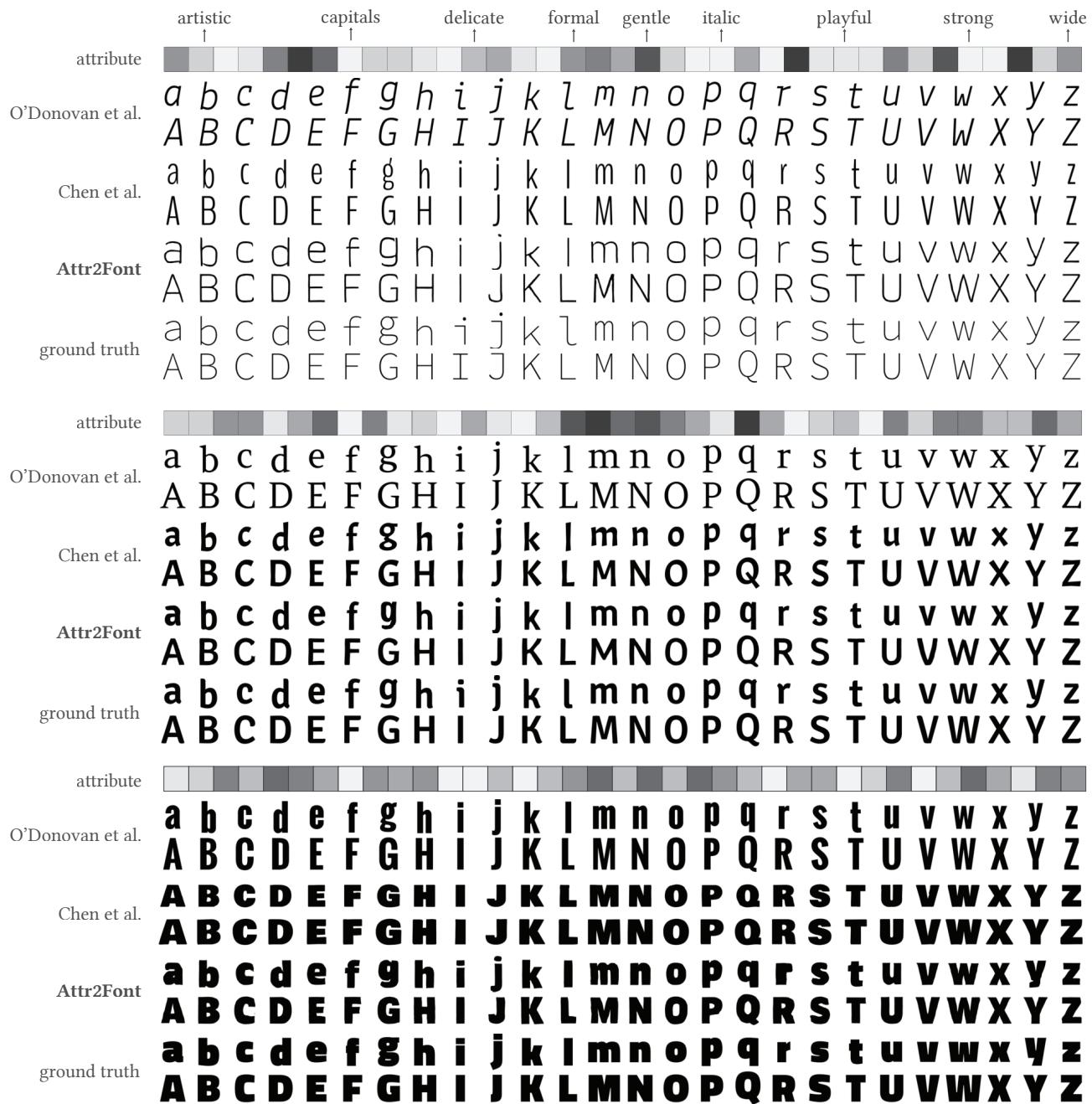


Fig. 16. Comparison of our model and two existing font retrieval methods.

source font	a b c d e f g h i j k l m n o p q r s t u v w x y z A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
random font	a b c d e f g h i j k l m n o p q r s t u v w x y z A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
random font	a b c d e f g h i j k l m n o p q r s t u v w x y z A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
random font	a b c d e f g h i j k l m n o p q r s t u v w x y z A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
random font	a b c d e f g h i j k l m n o p q r s t u v w x y z A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
random font	a b c d e f g h i j k l m n o p q r s t u v w x y z A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
random font	a b c d e f g h i j k l m n o p q r s t u v w x y z A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
random font	a b c d e f g h i j k l m n o p q r s t u v w x y z A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
random font	a b c d e f g h i j k l m n o p q r s t u v w x y z A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
random font	a b c d e f g h i j k l m n o p q r s t u v w x y z A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
random font	a b c d e f g h i j k l m n o p q r s t u v w x y z A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
random font	a b c d e f g h i j k l m n o p q r s t u v w x y z A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
random font	a b c d e f g h i j k l m n o p q r s t u v w x y z A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
random font	a b c d e f g h i j k l m n o p q r s t u v w x y z A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Fig. 17. The glyph images of a whole char-set generated by our method from random attribute values.

Font 1

Lorem ipsum dolor sit amet consectetur adipisicing elit sed do eiusmod tempor incididunt ut labore et dolore magna aliqua Ut enim ad minim veniam quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur Excepteur sint occaecat cupidatat non proident sunt in culpa qui officia deserunt mollit anim id est laborum

Font 2

Lorem ipsum dolor sit amet consectetur adipisicing elit sed do eiusmod tempor incididunt ut labore et dolore magna aliqua Ut enim ad minim veniam quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur Excepteur sint occaecat cupidatat non proident sunt in culpa qui officia deserunt mollit anim id est laborum

Font 3

Lorem ipsum dolor sit amet consectetur adipisicing elit sed do eiusmod tempor incididunt ut labore et dolore magna aliqua Ut enim ad minim veniam quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur Excepteur sint occaecat cupidatat non proident sunt in culpa qui officia deserunt mollit anim id est laborum

Fig. 18. Some continuous texts rendered by our model's generated fonts. We manually adjust the offsets of some characters. Font 1 is generated from a random set of attribute values. Font 2 and Font 3 are generated from two sets of attribute values in the validation dataset.