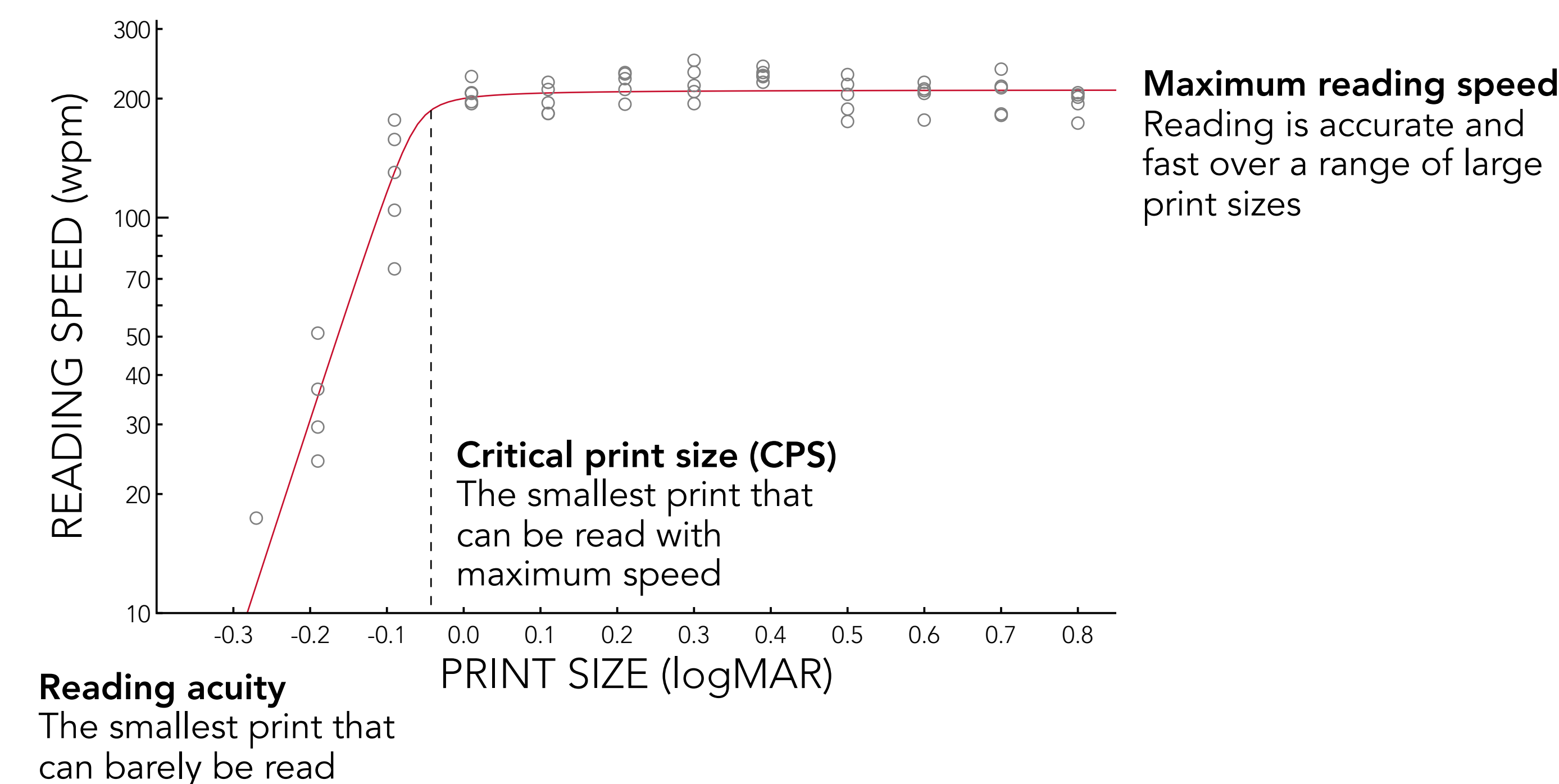


Linking letter recognition and the critical print size

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RATIONALE

Plots of reading speed as a function of print size show the following features:



The critical print size supports fast reading, and is typically about twice the size of the reading acuity limit.

What is going on at the critical print size that makes reading slow down?

Maybe the critical print size linked to letter recognition.

To explore this question, we took advantage of the fact that at small print sizes some letters are easier to recognize than others:

easy	d f g j k m p q v w y	d f g j k m p q v w y
hard	a b c e h i l n o r s t u x z	a b c e h i l n o r s t u x z

Based on recognition errors for individual blurred Times-Roman letters for 250ms exposures (Mansfield and West, 2017).

Hypothesis: Sentences containing many of these easy letters will have a smaller critical print size than sentences containing fewer easy letters.

METHOD

We selected sentences from our corpus of 116,000 computer-generated MNREAD sentences (Mansfield and Lewis, 2017).

We created two pools of sentences:

- *Easy*: containing many easy letters ($M=14.3$, $SD=0.81$)
- *Hard*: containing fewer easy letters ($M=4.7$, $SD=0.56$)

We measured reading speed versus print size curves using computer based version of the MNREAD acuity chart.

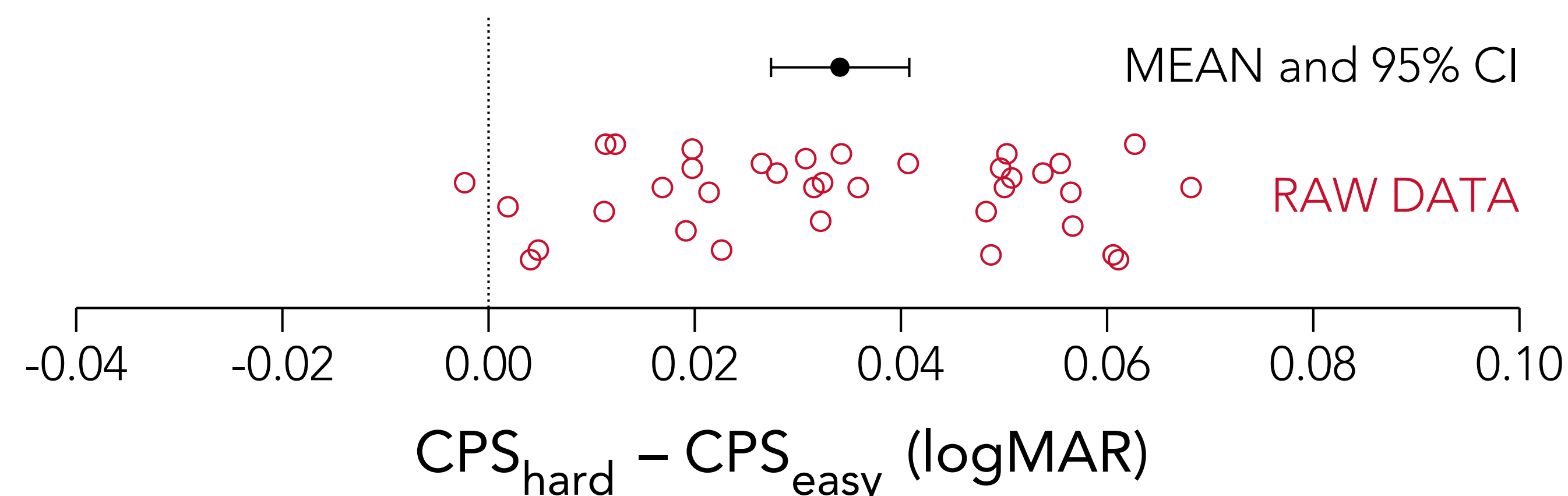
Print sizes ranged from -0.3 to +0.8 logMAR.

Data were collected from 36 college students with normal vision (or wearing their normal visual correction).

RESULTS

We estimated the critical print size (CPS) from curve fits to the reading-speed versus print-size data.

On average, the CPS for the hard sentences was 8.1% larger than the CPS for the easy sentences [95% CI: 6.5, 9.8], ($t_{35} = 10.3$, $p < 0.001$)



DISCUSSION

This finding is consistent with the critical print size being linked to letter recognition.

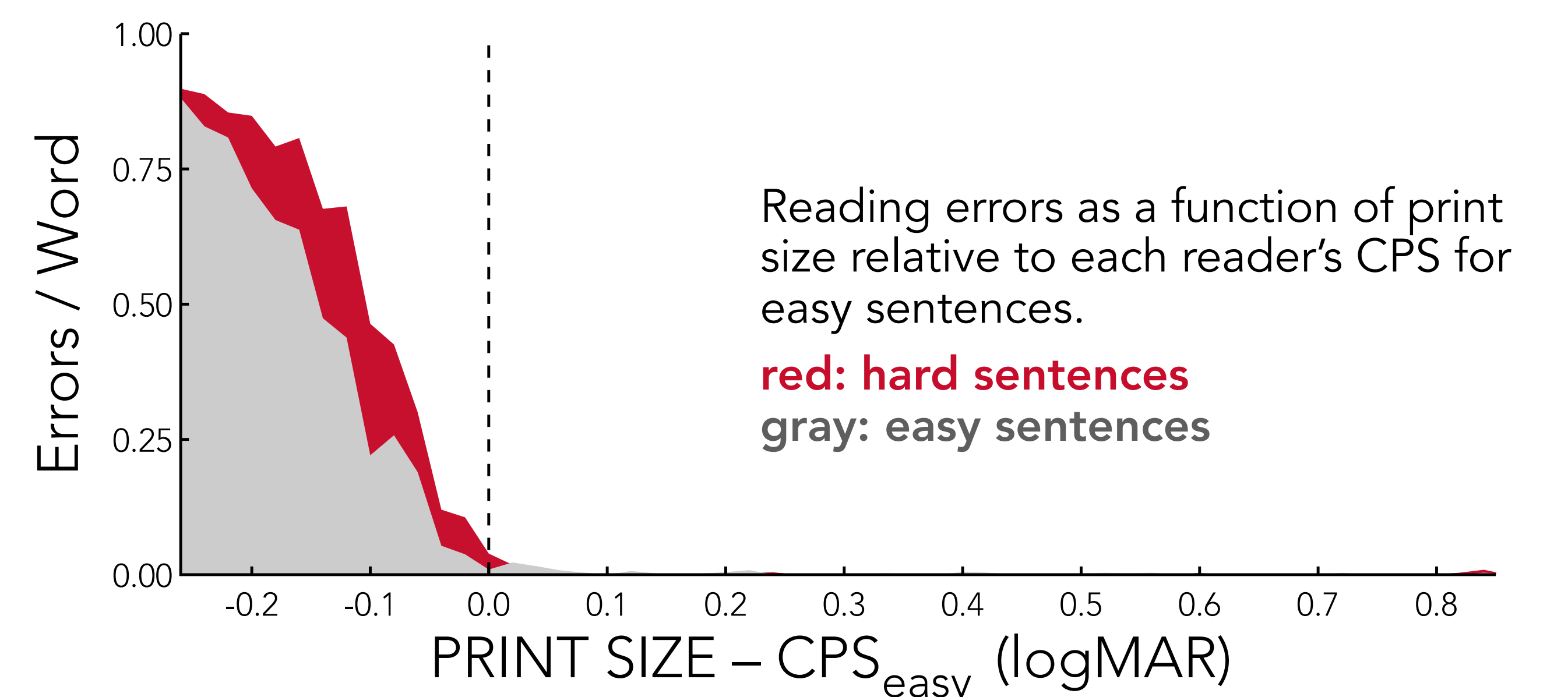
We propose that, with large print, letter recognition is accurate and reading is fast. But when print size is smaller than the critical print size, letter recognition becomes error prone and the reader is required to infer the identity of words that contain misidentified letters — this produces slower reading speeds.

Reading with letter recognition errors

Often it is possible to infer the meaning of words that contain hard-to-recognize letters. For example, in Times-Roman, confusions between e and c are common — ears sometimes looks like cars.

The value parked the cars.	Here, context suggests the word is cars. Reading errors are rare.
My aunt has two cars.	Here the context does not help. Reading errors are more likely.

We predict that the critical print size is also the size at which reading errors start to become common.



TRY IT!

How quickly can you read these sentences?

For print bigger than your CPS there is no difference in how quickly the hard (left) and easy (right) sentences are read

print size = 0.3 logMAR from 80cm

For print smaller than your CPS reading is slower, but which column is easiest to read?

print size = 0.0 logMAR from 80cm

The worker told me
their teachers threw
the snakes outdoors

The group said that
your cousin hid the
clue near the bench

My aunt hoped that
the police liked the
car near the church

Instead of watching
cartoons she should
march to the stream

Their boss said that
you must learn two
books about history

His uncle rode with
us in our green bus
to school yesterday

Rather than reading
you all might make
the street tomorrow

Your twins told me
the visitors saw the
babies on the beach

Our brother told us
the emperor put the
jeans near the shop

The nurse has a pet
horse with a brown
mark next to its ear

The chief told both
of you to clean our
room this afternoon

Their child told me
the hunters saw the
hats behind the bed

The visitors told us
my parents saw the
babies on the bench

The guards told me
their teachers threw
the orders outdoors

The owner said that
their coach saw the
car behind the shed

Rather than reading
he must continue to
the cellar tomorrow

The sailors told me
our team placed the
boxes near the shop

He noticed that our
cousin told you not
to run by the beach

Our sons wished all
the workers hid the
seats near the home

The students hoped
our doctors saw the
skates in the church

My brothers told us
the ghost found the
boats near the bank

All the twins asked me
for a cold glass of
milk with dinner

Instead of laughing
he will like to swim
in my pond tonight

My dad asked if all
the riders threw the
powder on the deck

My friend has a pet
bunny with a black
mark by its left eye

As well as sleeping
we may skip in the
woods if it is sunny

This hunter keeps a
dog with a big pink
patch under its paw

In place of fighting
you all might make
waves in their pool

As well as studying
she could disappear
from the ship today

The guard asked us
for some fruit juice
and a piece of cake

The driver said that
my doctors saw the
pump over the cliff

His family said that
of you to dust your
office by next week

The fairy asked for
a cup of coffee and
a bowl of ice cream

Along with helping
we may play in his
school if it is windy

In place of fighting
you all might make
waves in their pond

The wizard asked if
my twins threw the
pail over the bridge

Our mother keeps a
pig with a big pink
mark next to its eye

Your kids told both
of you to dust your
office by next week

The gang asked for
a cup of turkey and
rice soup for dinner

The police asked us
for a glass of warm
milk with breakfast

My dad told me not
to go near the trees
for most of the day

The people asked if
my family liked the
heels by the church

Your uncle said that
the visitors saw the
snakes outdoors

He noticed that the
workers hid the
seats near the home

The students hoped
our doctors saw the
skates in the church

The group said that
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My aunt hoped that
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Instead of watching
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References

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