Kognitionspsychologie: Session 9
Applications

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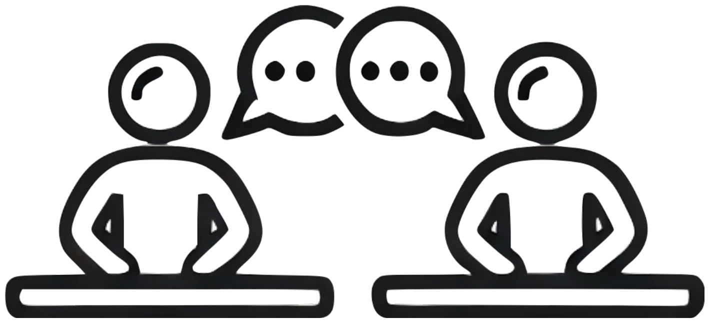
Learning Objectives

- Review applications - reading instruction, study techniques - to assess how cognitive psychology is used to develop real-world applications

- Compare and contrast the two applications to discuss theories, methods, and translational potential of cognitive psychology

REFLECT AND SUMMARIZE

What were your thoughts about Castles et al. (2018)?



Reading acquisition: Phonics instruction

The Alphabetic Code						
sounds + picture prompts	PI simple code Units 1-5	complex code	**graphemes (spelling alternatives) which are code for the sounds**			
/s/	s snake	-ce palace	-se house	ce cents	ci city	cy bicycle
	-ss glass	sc scissors	-st- castle	ps pseudonym		
/a/	a apple					
/t/	t tent	-tt letter	-ed skipped			
/i/	i insect	-y cymbals				
/p/	p pan	-pp puppet				
/n/	n net	-nn bonnet	kn knot	gn gnome	-ne engine	
/k/	k kit	c cat	-ck duck	ch chameleon	qu bouquet	que plaque
/e/	e egg	-ea head	-ai said again			
/h/	h hat	wh who				
/r/	r rat	-rr arrow	wr write	rh rhinoceros		
/m/	m map	-mm hammer	-me welcome	-mb thumb	-mn column	

/d/	d dig	-dd puddle	-ed rained			
/g/	g girl	-gg juggle	gu guitar	gh ghost	-gue catalogue	
/o/	o octopus	wa watch	qua qualify	al salt		
/u/	u umbrella	o son	-ou touch	-ough thoroughfare		
/l/	l ladder	-ll shell				
/ul/	-le kettle	-il pencil	-al hospital	-el camel		
/f/	f feathers	-ff cliff	ph photograph		-gh laugh	
/b/	b bat	-bb rabbit	bu building			
/j/	j jug	-ge cabbage	ge gerbil	gi giraffe	gy gymnast	-dge fridge
/y/	y yawn					
/ai/	ai aid	a table	-ae sundae	a-e cakes		
	-ay tray	-ey prey	eigh eight	-ea break	-aigh straight	
/w/	w web	wh wheel	-u penguin			
/igh/	-igh night	-ie tie	i behind	-y shy	i-e bike	ei eider duck

https://www.jocelynseamereducation.com/blog/46913-phonemes-and-graphemes

Reading acquisition: Phonics instruction

Why it should work

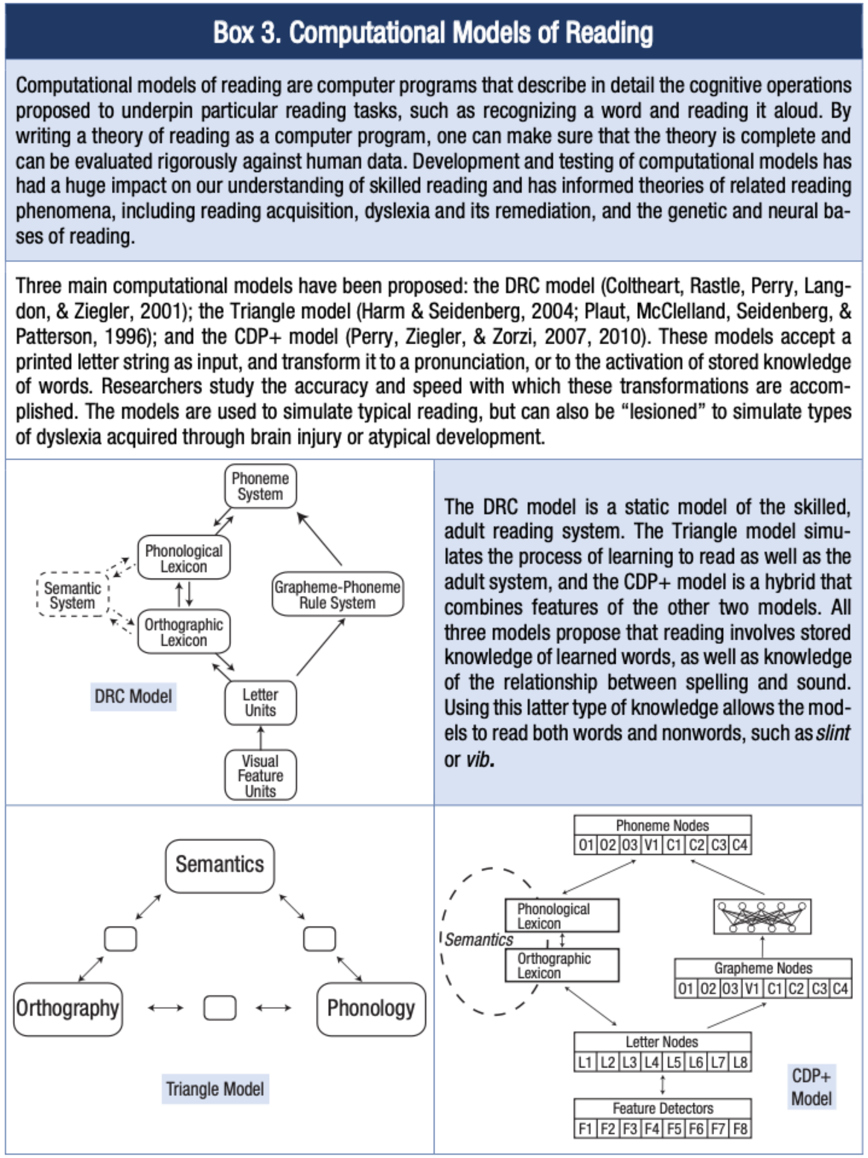
"Systematic phonics refers to reading instruction programs that teach pupils the relationship between **graphemes** and **phonemes** in an **alphabetic writing system**. As explained above, the rationale for systematic phonics instruction is that a relatively small body of knowledge of how graphemes relate to phonemes provides children with the ability to decode most words in their language. Provided that children have adequate vocabulary, this sound-based representation can then be used to access the meanings of those words. If instruction instead focused on teaching children to associate printed words with their meanings directly, then learning to read would require memorization of tens of thousands of individual printed words. Thus, systematic phonics instruction should be viewed as a natural and logical consequence of the manner in which alphabetic writing systems represent spoken language."

Assessment

A large body of research, including several meta-analyses, has demonstrated that systematic phonics instruction improves decoding, spelling, and reading comprehension in young children. For example, a highly influential meta-analysis conducted by the National Reading Panel found a moderate effect size of 0.41 for phonics instruction compared to other approaches. This effect was even stronger when phonics instruction began early (d= 0.55).

Castles, A., Rastle, K., & Nation, K. (2018). Ending the reading wars: Reading acquisition from novice to expert. *Psychological Science in the Public Interest, 19*(1), 5–51. https://doi.org/10.1177/1529100618772271

Reading acquisition: Phonics instruction



Box 3. Computational Models of Reading

Computational models of reading are computer programs that describe in detail the cognitive operations proposed to underpin particular reading tasks, such as recognizing a word and reading it aloud. By writing a theory of reading as a computer program, one can make sure that the theory is complete and can be evaluated rigorously against human data. Development and testing of computational models has had a huge impact on our understanding of skilled reading and has informed theories of related reading phenomena, including reading acquisition, dyslexia and its remediation, and the genetic and neural bases of reading.

Three main computational models have been proposed: the DRC model (Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001); the Triangle model (Harm & Seidenberg, 2004; Plaut, McClelland, Seidenberg, & Patterson, 1996); and the CDP+ model (Perry, Ziegler, & Zorzi, 2007, 2010). These models accept a printed letter string as input, and transform it to a pronunciation, or to the activation of stored knowledge of words. Researchers study the accuracy and speed with which these transformations are accomplished. The models are used to simulate typical reading, but can also be "lesioned" to simulate types of dyslexia acquired through brain injury or atypical development.

The DRC model is a static model of the skilled, adult reading system. The Triangle model simulates the process of learning to read as well as the adult system, and the CDP+ model is a hybrid that combines features of the other two models. All three models propose that reading involves stored knowledge of learned words, as well as knowledge of the relationship between spelling and sound. Using this latter type of knowledge allows the models to read both words and nonwords, such as *slint* or *vib*.

Cognitive models of reading can help provide some insight into why phonics instruction works. Extant models acknowledge two primary mechanisms for word reading:

- Phonological Pathway: This pathway involves translating a word's spelling into sound, and then using that sound to access the word's meaning. This pathway is crucial for reading unfamiliar words and nonwords, and is heavily reliant on the skills developed through phonics instruction.
- Direct Pathway: This pathway allows skilled readers to access a word's meaning directly from its spelling, without the need for phonological decoding. This pathway is faster and more efficient for reading familiar words.

Phonics instruction can play a role in developing both pathways: The act of decoding, while initially slow and effortful, provides children with the opportunity to learn the orthographic representations of words—their spellings. This orthographic knowledge gradually builds up, allowing for the development of the direct pathway and fluent word recognition.

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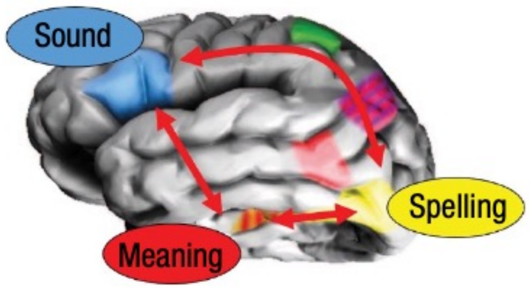
Reading acquisition: Phonics instruction

Box 4. The Neural Bases of Reading

The past 20 years have seen increasing interest in how the brain supports skilled reading and its development. A recent meta-analysis bringing together neuroimaging studies of reading in alphabetic writing systems has yielded strong support for the proposal that there are two pathways to computing meaning from print (Taylor, Rastle, & Davis, 2013). The neural model of reading resulting from this meta-analysis is presented below. A *dorsal pathway* underpins phonologically mediated reading, and a *ventral pathway* underpins direct access to meaning from print. This model is also supported by neuropsychological data. For example, patients with damage to areas of the dorsal pathway have difficulty reading nonwords (e.g., Woollams & Patterson, 2012), whereas patients with damage to areas of the ventral pathway have particular difficulties reading words with atypical spelling-sound mappings (e.g., Woollams, Ralph, Plaut, & Patterson, 2007).

Regions within the left-hemisphere ventral pathway dubbed the "visual word form area" have been of particular interest to reading researchers (for review, see Dehaene & Cohen, 2011). This region appears to be tuned to written language; for example, it responds more strongly to words and nonwords than to consonant strings (Cohen et al., 2002). Further work characterizing this region has revealed a posterior-to-anterior gradient, with increasing sensitivity to higher-level properties of words (e.g., letters, bigrams, quadrigrams; Vinckier et al., 2007).



Neural Pathways of Skilled Reading (adapted from Rastle, 2018)

Much less research has considered how the brain changes through reading development. Nevertheless, a recent meta-analysis of neuroimaging studies of reading in children revealed a network of dorsal- and ventral-pathway brain regions similar to that observed in adults (Martin, Schurz, Kronbichler, & Richlan, 2015). One interesting proposal that is consistent with the characterization of reading acquisition that we have put forward is that reliance gradually shifts with increasing reading skill from the dorsal to the ventral pathway (Pugh et al., 2000; Shaywitz et al., 2002). This is consistent with longitudinal data suggesting that areas of the ventral pathway continue to increase in sensitivity to printed words into adolescence (Ben-Shachar, Dougherty, Deutsch, & Wandell, 2011) and that this increase is associated with speeded word reading performance, but not nonword reading performance or phonological processing skill.

Neural models of reading provide a biological basis for this dual-pathway architecture. Research has identified two distinct neural pathways involved in reading:

- Dorsal Pathway: This pathway, located in the upper part of the brain, supports phonologically mediated reading, similar to the phonological pathway in cognitive models.
- Ventral Pathway: This pathway, situated in the lower part of the brain, is believed to underpin the direct pathway, enabling the rapid recognition of familiar words from their spellings.

Studies of reading development suggest a shift in reliance from the dorsal pathway to the ventral pathway as children become more skilled readers. This shift aligns the idea that phonics instruction, by strengthening the phonological pathway and promoting orthographic learning, paves the way for the development of the direct pathway and fluent reading.

Castles, A., Rastle, K., & Nation, K. (2018). Ending the reading wars: Reading acquisition from novice to expert. *Psychological Science in the Public Interest, 19*(1), 5–51. https://doi.org/10.1177/1529100618772271

Practice Question

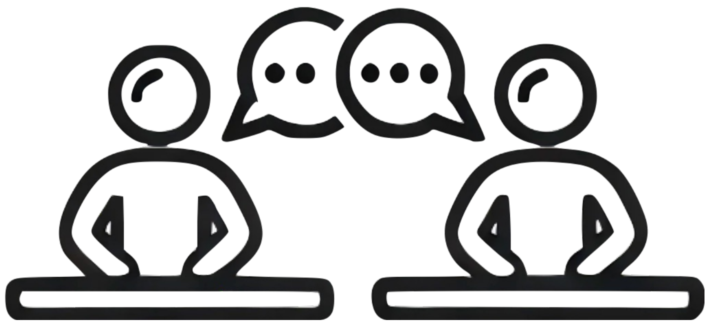
Imagine a psychologist interested in improving reading abilities by introducing the phonics instruction method in the schools of the local community. The psychologist discusses this possibility with the responsible individual in the Educational Department but receives the following reaction:

> "There is much more to reading than mapping sounds to letters – one needs to understand FULL words and sentences!"

What arguments, if any, would the psychologist have to justify reliance on the phonics method given Castles et al. (2018) review?

REFLECT AND SUMMARIZE

What were your thoughts about Dunlosky et al. (2013)?



Effective learning techniques

Table 1. Learning Techniques

Technique	Description
1. Elaborative interrogation	Generating an explanation for why an explicitly stated fact or concept is true
2. Self-explanation	Explaining how new information is related to known information, or explaining steps taken during problem solving
3. Summarization	Writing summaries (of various lengths) of to-be-learned texts
4. Highlighting/underlining	Marking potentially important portions of to-be-learned materials while reading
5. Keyword mnemonic	Using keywords and mental imagery to associate verbal materials
6. Imagery for text	Attempting to form mental images of text materials while reading or listening
7. Rereading	Restudying text material again after an initial reading
8. Practice testing	Self-testing or taking practice tests over to-be-learned material
9. Distributed practice	Implementing a schedule of practice that spreads out study activities over time
10. Interleaved practice	Implementing a schedule of practice that mixes different kinds of problems, or a schedule of study that mixes different kinds of material, within a single study session

Note. See text for a detailed description of each learning technique and relevant examples of their use.

Dunlosky, J., Rawson, K. A., Marsh, E. J., Nathan, M. J., & Willingham, D. T. (2013). Improving students' learning with effective learning techniques: Promising directions from cognitive and educational psychology. *Psychological Science in the Public Interest, 14*(1), 4–58. https://doi.org/10.1177/1529100612453266

Effective learning techniques

Table 4. Utility Assessment and Ratings of Generalizability for Each of the Learning Techniques

Technique	Utility	Learners	Materials	Criterion tasks	Issues for implementation	Educational contexts
Elaborative interrogation	Moderate	P-I	P	I	P	I
Self-explanation	Moderate	P-I	P	P-I	Q	I
Summarization	Low	Q	P-I	Q	Q	I
Highlighting	Low	Q	Q	N	P	N
The keyword mnemonic	Low	Q	Q	Q-I	Q	Q-I
Imagery use for text learning	Low	Q	Q	Q-I	P	I
Rereading	Low	I	P	Q-I	P	I
Practice testing	High	P-I	P	P	P	P
Distributed practice	High	P-I	P	P-I	P	P-I
Interleaved practice	Moderate	I	Q	P-I	P	P-I

Note: A positive (P) rating indicates that available evidence demonstrates efficacy of a learning technique with respect to a given variable or issue. A negative (N) rating indicates that a technique is largely ineffective for a given variable. A qualified (Q) rating indicates that the technique yielded positive effects under some conditions (or in some groups) but not others. An insufficient (I) rating indicates that there is insufficient evidence to support a definitive assessment for one or more factors for a given variable or issue.

Dunlosky, J., Rawson, K. A., Marsh, E. J., Nathan, M. J., & Willingham, D. T. (2013). Improving students' learning with effective learning techniques: Promising directions from cognitive and educational psychology. *Psychological Science in the Public Interest, 14*(1), 4–58. https://doi.org/10.1177/1529100612453266

Effective learning techniques: Practice testing

Why it should work

“Attempting to retrieve target information involves a search of long-term memory that activates related information, and this activated information may then be encoded along with the retrieved target, forming an elaborated trace that affords multiple pathways to facilitate later access to that information.”

Assessment

“On the basis of the evidence described above, we rate practice testing as having **high utility**. Testing effects have been demonstrated across an impressive range of practice-test formats, kinds of material, learner ages, outcome measures, and retention intervals. Thus, practice testing has broad applicability. Practice testing is not particularly time intensive relative to other techniques, and it can be implemented with minimal training. Finally, several studies have provided evidence for the efficacy of practice testing in representative educational contexts.”

Dunlosky, J., Rawson, K. A., Marsh, E. J., Nathan, M. J., & Willingham, D. T. (2013). Improving students' learning with effective learning techniques: Promising directions from cognitive and educational psychology. *Psychological Science in the Public Interest, 14*(1), 4–58. https://doi.org/10.1177/1529100612453266

Effective learning techniques: Practice testing

There are likely many reasons why testing works…

"Although many studies have shown that testing alone outperforms restudy, some studies have failed to find this advantage (in most of these cases, accuracy on the practice test has been relatively low). In contrast, the advantage of practice testing with feedback over restudy is extremely robust. Practice testing with feedback also consistently outperforms practice testing alone."

Table 1 Ten Benefits of Testing

Benefit 1	The testing effect: retrieval aids later retention
Benefit 2	Testing identifies gaps in knowledge
Benefit 3	Testing causes students to learn more from the next learning episode
Benefit 4	Testing produces better organization of knowledge
Benefit 5	Testing improves transfer of knowledge to new contexts
Benefit 6	Testing can facilitate retrieval of information that was not tested
Benefit 7	Testing improves metacognitive monitoring
Benefit 8	Testing prevents interference from prior material when learning new material
Benefit 9	Testing provides feedback to instructors
Benefit 10	Frequent testing encourages students to study

Roediger Iii, H. L., Putnam, A. L., & Smith, M. A. (2011). Ten benefits of testing and their applications to educational practice. In Psychology of Learning and Motivation (Vol. 55, pp. 1–36). Elsevier. https://doi.org/10.1016/B978-0-12-387691-1.00001-6

Effective learning techniques: Highlighting

Why it should work

“Actively selecting information should benefit memory more than simply reading marked text (…). Marked text draws the reader’s attention, but additional processing should be required if the reader has to decide which material is most important. Such decisions require the reader to think about the meaning of the text and how its different pieces relate to one another.”

Assessment

“On the basis of the available evidence, we rate highlighting and underlining as having **low utility**. In most situations that have been examined and with most participants, highlighting does little to boost performance. It may help when students have the knowledge needed to highlight more effectively, or when texts are difficult, but it may actually hurt performance on higher- level tasks that require inference making. Future research should be aimed at teaching students how to highlight effectively, given that students are likely to continue to use this popular technique despite its relative ineffectiveness.”

Dunlosky, J., Rawson, K. A., Marsh, E. J., Nathan, M. J., & Willingham, D. T. (2013). Improving students’ learning with effective learning techniques: Promising directions from cognitive and educational psychology. *Psychological Science in the Public Interest, 14*(1), 4–58. https://doi.org/10.1177/1529100612453266

Practice Question

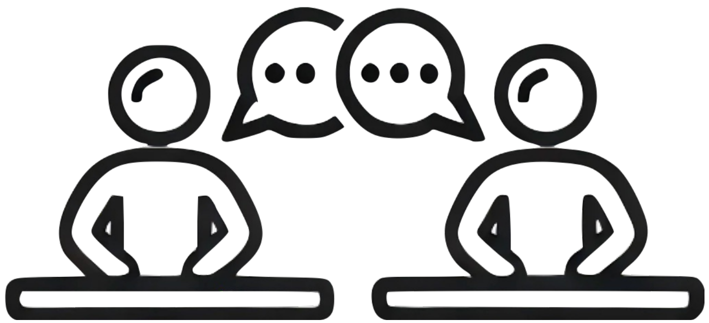
Imagine a professor of psychology created a practice (mock) exam for students to prepare for a BSc course. The professor opted to first provide only the questions, and, a week later, the correct answers. The professor receives the following feedback from the course evaluation at the end of the semester:

> "You should upload the results of the mock exam in advance. Why not upload it all at once so we can revise when we want, we are not in high school anymore."

What arguments, if any, would the professor have to justify the uploading of results a week later, given the Dunlosky et al. (2013) review?

COMPARE AND CONTRAST

What are the main similarities or differences between the two papers?



Course evaluation

https://evasys.unibas.ch/evasys/online.php?pswd=XM8F3