Use only English to answer the following questions. Your answers will be graded on the clarity of the exposition, as well as on the appropriateness, correctness and relevance of the particular examples and facts that you use to illustrate or to support your points.

1. Please write a summary of approximately half a page. (25%)
2. The author mentioned the two versions of linguistic relativity hypothesis. After reading the experiment laid out in the article, do you think there is more support for the strong version or the weak version? What is the significance of this study as compared to previous findings? (25%)

Our Language Affects What We See

— A new look at "the Russian Blues" demonstrates the power of words to shape perception By Catherine L. Caldwell-Harris, Ph.D. on January 15, 2019

Does the language you speak influence how you think? This is the question behind the famous linguistic relativity hypothesis, that the grammar or vocabulary of a language imposes on its speakers a particular way of thinking about the world.

The strongest form of the hypothesis is that language determines thought. This version has been rejected by most scholars. A weak form is now thought to be obviously true, which is that if one language has a specific vocabulary item for a concept but another language does not, then speaking about the concept may happen more frequently or more easily. For example, if someone explained to you, an English speaker, the meaning for the German term *Schadenfreude*, you could recognize the concept, but you may not have used the concept as regularly as a comparable German speaker.

Scholars are now interested in whether having a vocabulary item for a concept influences thought in domains far from language, such as visual perception. Consider the case of the "Russian blues." While English has a single word for blue, Russian has two words, *goluboy* for light blue and *siniy* for dark blue. These are considered "basic level" terms, like green and purple, since no adjective is needed to distinguish them. Lera Boroditsky and her colleagues displayed two shades of blue on a computer screen and asked Russian speakers to determine, as quickly as possible, whether the two blue colors were different from each other or the same as each other. The fastest discriminations were when the displayed colors were *goluboy* and *siniy*, rather than two shades of *goluboy* or two shades of *siniy*. The reaction time advantage for lexically distinct blue colors was strongest when the blue hues were perceptually similar.

To determine if words were being automatically (and perhaps unconsciously) activated, the researchers added the following twist: they asked their Russian participants to perform a verbal task at the same time as making their perceptual discrimination. This condition eliminated the reaction time advantage of contrasting *goluboy* and *siniy*. However, a nonverbal task (a spatial task) could be done at the same time while retaining the *goluboy/siniy* advantage. The dual task variants indicated that the task of discriminating color patches was aided by silent activation of verbal categories. English speakers tested on the identical discrimination tasks showed no advantage for the light blue / dark blue trials.

Recently the Russian Blues have been used again to investigate how language influences thought. In the journal Psychological Science, Martin Maier and Rasha Abdel Rahman investigated whether the color distinction in the "Russian Blues" would help the brain become consciously aware of a stimulus which might otherwise go unnoticed. Would salience help a light blue color, or a dark blue color be noticed (i.e., enter conscious awareness) in a situation in which attention is overloaded and not all stimuli can be noticed?

The task selected to investigate this is the "attentional blink." This is an experimental paradigm frequently used to test whether a stimuli is consciously noticed. Research participants are asked to monitor a sequence of stimuli, displayed at high speeds

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(typically at least 10 per second), and to press a button every time they see a certain item. The searched-for-item can be a letter amidst a sequence of numbers; or that target can be, for example, an emotion word of in a sequence neutral words. Participants are very good at detecting the first target they see, but if a second target follows immediately after the first, or with a lag of 2-3 items, the second target can be missed. It is as if the brain's attentional system "blinked." The reason for the missed item can be understood intuitively: the brain was busy processing the first target and didn't have attentional resources to spare to detect the second target.

In the decades since it was discovered, the attentional blink has been used in myriad ways to document what stimuli have an advantage in capturing attention. For example, imagine that you are asked to monitor for instances of proper names in a stream of rapidly displayed nouns. You do not miss your own name even if it occurs after a prior target. Researchers conclude that the salience of your own name protects it from the attentional blink.

Would the salience of a blue color contrast, using the Russian Blues, protect a stimulus from the attentional blink? The authors tested whether colored triangles could be detected more easily when the triangles were made visually salient by being positioned against a contrasting color. For example, a dark green color against a light green background is harder to see than a dark green color against a dark blue background. Green against blue is easier to see because of the strong color contrast between dark blue and dark green provided by linguistic categorization. What if the colors were *goluboy* and *siniy*? For Russians speakers, contrasting light and dark blue should be as salient as the contrast between dark green and dark blue (always being careful to keep perceptual similarity between contrasting stimuli comparable).

Maier and Rahman designed stimuli that were geometric shapes positioned against a light blue circle. The task of research participants was to press a button when they saw either a semi-circle or a triangle, ignoring stars, squares, diamonds and other shapes. Distractor shapes were plain grey shapes against a light blue background. As noted, the targets, which were triangles or semi-circles, were colored in ways that allowed their visual distinctiveness to be precisely varied. The least salient triangle was a light green triangle against a dark green background. This was not salient because the two green colors are in the same linguistic category. A highly salient stimulus was a green (either light or dark green) triangle against a blue (either light or dark blue) background, because the colors were in different linguistic categories. A stimulus which would also be highly salient for Russian speakers was a light or dark blue triangle positioned against a circle with the differing blue color.

The attentional blink task contained a sequence of 2-6 stimuli to be ignored (non-target shapes), then a colored semi-circle (target 1), and then, followed by a lag of either 3 or 7 items, the second target, a triangle. At lag 3, when participants' brains were busy processing target 1, how difficult would it be to detect the green triangle?

The results supported the hypothesis that the linguistic distinction of the Russian Blues helps stimuli enter conscious awareness. That is, the least salient targets, green triangles on green backgrounds, were missed the most. The easiest target to detect was the blue/green contrast. But importantly, the contrast between *goluboy* (light blue) and *siniy* (dark blue) was a stimulus that grabbed the brain's attention centers more than the light green / dark green contrast. Interestingly, these results were also found in a study of Greek speakers, as Greek resembles Russian in having separate lexical items for light and dark blue. German was used as the 'control' language since like English, it has only one word for blue. For German speakers, detection rates of the blue/blue and green/green trials were identical.

What is occurring in the brain during this visual task? The authors monitored scalp potentials during the attentional blink task. When blue contrasts were detected (meaning the blink was avoided), an event related potential occurred that is known to accompany the stage of early visual processing. This neural signature was not present for the light green / dark green stimulus, indicating that the brain processes the light blue / dark blue differently, for speakers whose language makes a lexical distinction.

The current study is an important advance in documenting how linguistic categories influence perception. Consider how this updates the original Russian Blues study, in which observers pressed a button to indicate whether two shades of blue were the same or different. In that study, it seems likely that observers silently labeled colors in order to make fast decisions. It is less likely that labeling was used during the attentional blink task, because paying attention to color is not required and indeed was irrelevant to the task. All observers had to do is try to detect a triangle in a rapid sequence of diverse shapes. It is thus a powerful

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finding that the incidental contrast of dark blue triangle against a light blue background helped push the triangle into conscious awareness.

What arenas of perceptual-linguistic interaction remain to be conquered? The current finding indicates that linguistic knowledge can influence perception, contradicting the traditional view that perception is processed independently from other aspects of cognition, including language. This is most famously seen in the case of visual illusions, which are mostly impervious to knowledge about the illusion. Hmm. One wonders: Could the Russian Blues be recruited in altering a visual illusion that depends on color shades?

3. Consider the following question, "*If a tree falls in the forest and no one is there to hear it, is there a sound?*" Please answer this question from both a physical and a perceptual point of view. Limit your answer to 200 words. (20%)

4. Below are two abstracts on how infants and toddlers may perceive native and non-native sounds. Please read through them carefully and answer the following questions.

Infant ability to tell voices apart rests on language experience

A visual fixation study tested whether 7-month-olds can discriminate between different talkers. The infants were first habituated to talkers producing sentences in either a familiar or unfamiliar language, then heard test sentences from previously unheard speakers, either in the language used for habituation, or in another language. When the language at test mismatched that in habituation, infants always noticed the change. When language remained constant and only talker altered, however, infants detected the change only if the language was the native tongue. Adult listeners with a different native tongue from the infants did not reproduce the discriminability patterns shown by the infants, and infants detected neither voice nor language changes in reversed speech; both these results argue against explanation of the native-language voice discrimination in terms of acoustic properties of the stimuli. The ability to identify talkers is, like many other perceptual abilities, strongly influenced by early life experience.

Johnson EK, Westrek E, Nazzi T, Cutler A. (2011) Infant ability to tell voices apart rests on language experience. *Developmental Science, 14*, 1002–1011.

Early development of abstract language knowledge: evidence from perception–production transfer of birth-language memory

Children adopted early in life into another linguistic community typically forget their birth language but retain, unaware, relevant linguistic knowledge that may facilitate (re)learning of birth-language patterns. Understanding the nature of this knowledge can shed light on how language is acquired. Here, international adoptees from Korea with Dutch as their current language, and matched Dutch-native controls, provided speech production data on a Korean consonantal distinction unlike any Dutch distinctions, at the outset and end of an intensive perceptual training. The productions, elicited in a repetition task, were identified and rated by Korean listeners. Adoptees' production scores improved significantly more across the training period than control participants' scores, and, for adoptees only, relative production success correlated significantly with the rate of learning in perception (which had, as predicted, also surpassed that of the controls). Of the adoptee group, half had been adopted at 17 months or older (when talking would have begun), while half had been prelinguistic (under six months). The former group, with production experience, showed no advantage over the group without. Thus the adoptees' retained knowledge of Korean transferred from perception to production and appears to be abstract in nature rather than dependent on the amount of experience.

Choi, J., Cutler, A., & Broersma, M. (2017). Early development of abstract language knowledge: evidence from perception–production transfer of birth-language memory. *Royal Society open science, 4*(1), 160660.

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4.1. According to the abstracts, what factor(s) may play a key role in the development of infants'/toddlers' speech perception? Which position do you agree with, or do you think that both proposals have their own significance? Give your reasons and arguments with a limit of 300 words. (20%)

4.2. Consider the following abstract of another study. With this proposal, would you change or modify your position for Question 4.1? Limit your answer to 150 words. (10%)

Statistical Learning by 8-Month-Old Infants

Learners rely on a combination of experience-independent and experience-dependent mechanisms to extract information from the environment. Language acquisition involves both types of mechanisms, but most theorists emphasize the relative importance of experience-independent mechanisms. The present study shows that a fundamental task of language acquisition, segmentation of words from fluent speech, can be accomplished by 8-month-old infants based solely on the statistical relationships between neighboring speech sounds. Moreover, this word segmentation was based on statistical learning from only 2 minutes of exposure, suggesting that infants have access to a powerful mechanism for the computation of statistical properties of the language input.

Saffran, J. R., Aslin, R. N., & Newport, E. L. (1996). Statistical learning by 8-month-old infants. *Science, 274*(5294), 1926-1928.

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