Psychological Reports, 2010, 107, 2, 443-446.

THE ODD EFFECT AND MULTIPLE MEANINGS IN ENGLISH OF THE WORDS "ODD" AND "EVEN"[1]

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Summary.—Under a variety of conditions, people take longer to make judgments about odd than about even digits and digit names. In English the words "odd" and "even" have multiple meanings. Perhaps the multiple meanings of these words are responsible for the slowing of responses to odd stimuli. This hypothesis was tested using participants who spoke no English and in whose native language, Polish, the words for the mathematical concepts of odd and even do not have multiple meanings.

The "odd effect" refers to the finding that, under a variety of conditions, it takes people longer to make judgments about odd than about even digits and digit names. Depending on the specific conditions of the task involved, the difference ranges from about 100 msec. to about 200 msec. (Hines, 1990). Hines suggested that the reason for this effect is that "odd" is a linguistically marked concept while "even" is unmarked and noted evidence that marked adjectives require greater processing time. The unmarked adjective in a pair has a lower word frequency and can take a negative prefix, while the marked member cannot take a negative prefix. Children learn the unmarked member of a marked/unmarked adjective pair before they learn the marked member (E. Clark, 1973; H. Clark, 1973). Hines reanalyzed data from two early studies (Clapp, 1924; Knight & Behrens, 1928) of the ease with which children learned arithmetic problems. Both studies showed that children take longer to learn sums of two odd numbers than two even numbers. Clapp ranked the difficulty of all 100 single-digit addition problems. The average rank for the odd plus odd problems was 79; for the even plus even problems it was 57. Knight and Behrens' rankings of the same problems were 83 for the odd and 68 for the even. Conceptually, a marked adjective may be thought of as noting the absence of the characteristic of the unmarked adjective, but not the reverse. Thus, *dead* is a marked adjective because death is the absence of life and one can say *undead* but not *unalive*.

There is, however, a second possible linguistic explanation for the "odd effect." In English, the word "odd" has at least two very different meanings. One is mathematical and indicates that an odd number is not

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DOI 10.2466/04.10.11.22.PR0.107.5.443-446 ISSN 0033-2941

evenly divisible by two. The other denotes something strange or unusual. The word "even" also has a mathematical meaning and other meanings (i.e., smooth). Perhaps something about the multiple meanings of these words is associated with the differential response speeds to judgments about odd and even stimuli.

To test this hypothesis, it would be necessary to find a language in which the words denoting the mathematical meaning of "odd" and "even" do not carry other meanings. Polish is such a language. In Polish, the word for the mathematical concept *odd* is "neiparzysty" and has no connotation of strangeness or other meanings as does "odd." The Polish word meaning strange or unusual is "dziwny." The Polish word for the mathematical concept *even* is "parzysty" (Stanislawski, 1964; Stanislawski & Szercha, 1969). If a slower response to odd digits is associated with the multiple meanings of *odd* and *even* in English, this slowing should not be present in a sample of Polish respondents who speak no English. This experiment tested this hypothesis. Hines, Herman-Jeglinska, Bednarek, and Grabowska (1996) examined hemispheric differences in the odd effect with Polish speaking participants, but many of these did speak English. However, that study was not designed specifically to test the present hypothesis.

Since previous experiments in English (Hines, 1990) have clearly established the occurrence of an odd effect in English, there was no need to include an English-speaking group in the present study. The goal of the present study was not to compare the magnitude of the "odd effect" in the two languages but simply to assess whether the effect is observed in a Polish-speaking group. Should the effect not be observed in the Polish-speaking group, further research would be required to specify what it is about the nature of the words in English that leads to the effect.

Method

Participants

Participants were 24 University of Warsaw undergraduates, 19 women and 5 men, whose mean age was 20.5 yr. ($SD = 2.5$). Five participants made over 20% errors and their data were not used. Participants were native Polish speakers who spoke no English. They were paid the equivalent in Polish currency of U.S. $3. for their participation.

Apparatus and Procedure

Testing was conducted by a native Polish-speaking psychology major who read the instructions and answered any questions from participants. Testing took place at the Psychology Department of the University of Warsaw. Participants sat at a self-selected distance in front of a monitor controlled by an IBM P2, Model 50 computer, which controlled stimulus presentation and response recording. Stimuli were of pairs of digits se-

lected from 2 through 9, separated by four blank spaces. Digit pairs were presented centered on the computer screen. No identical digit pairs were presented. There were 188 trials of which 47 consisted of two even and 47 of two odd digits. On the remaining 94 trials, one digit was odd and one even. On 47 of these trials, the odd digit was on the left, and on the other 47, it was on the right. A practice block of 20 trials preceded the actual experimental trials.

Participants were instructed to press the "A" key on the computer keyboard with the left index finger if the two digits were both odd or both even, or the single quote (') key with the right index finger if one digit was odd and one even. The crucial comparison in this study, between responses when the two stimuli were both odd or both even, was made by the same hand. Participants were asked to respond as quickly and accurately as possible.

When a correct response was given, feedback in the form of that trial's reaction appeared on the screen. If an error was made the word "ERROR" appeared. If the reaction time was greater than 1,500 msec. "TOO SLOW" appeared. This feedback was in English as no Polish character set was available for the computer. The meaning of the feedback was explained before the experiment began. Following a response, the stimuli were removed from the screen and the feedback appeared, remaining visible for 1,200 msec. Following a 1,500-msec. intertrial interval, the next stimulus pair appeared.

Results and Discussion

Participants performed significantly more slowly on trials on which both digits were odd than on even/even trials. Reaction time was slower, 1,017 msec. ($SD = 120$) versus 803 msec. ($SD = 122$). This difference was significant ($t_{18} = 8.48$, $p < .001$, Cohen's $d = 1.70$). There were also significantly more errors on odd/odd trials, 11.3% (5.4) versus 2.2% (1.4; $t_{18} = 6.74$, $p < .001$, Cohen's $d = 2.70$). The mean reaction time for the different trials was 973 msec. ($SD = 104$). The mean error rate was 6.0% ($SD = 2.9$).

The analysis shows that odd digits were responded to more slowly even in a language in which the words for the mathematical concepts *odd* and *even* have no additional meanings. The size of the difference in reaction time, 214 msec., is comparable to the 209-msec. difference found in the very similar task used in Exp. 1 in Hines (1990). This finding provides additional support for the markedness explanation for the odd effect. *Neiparzysty* is marked in Polish. In fact, it literally translates as *uneven* or "not even." Just as it is improper to say *unodd* in English, one cannot say *nei neiparzysty* in Polish.

Markedness as an explanation, however, seems somewhat incomplete. It does not address the issue of what aspects of the internal repre-

sentations of marked and unmarked concepts are important in the slowing of responses to marked concepts. Perhaps the internal representations of exemplars which are unmarked are linked more closely in semantic memory than marked representations. This is an issue for future research.

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Accepted August 19, 2010.