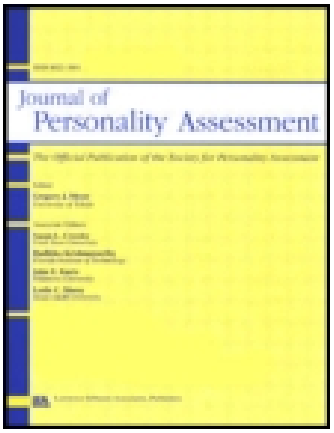

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What Is It That Color Determinants Determine? The Relation Between the Rorschach Inkblot Method and Cognitive Object-Recognition Processes

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ARTICLES

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We sought to demonstrate a relation between the Determinants in the Rorschach Inkblot Method (Rorschach, 1921) and fundamental properties of the participant's cognitive (visual) system by examining whether the report about Color Determinants is related to basic cognitive processes concerned with color of visual objects. In Experiment 1, we established an object-naming task that is sensitive to the objects' color. Participants were strongly influenced by the object's color, responding fastest when objects appeared in their typical color and slowest when the object's color was atypical. In Experiment 2, we examined the relationship between the Color Determinants in the Rorschach Inkblot Method and the magnitude of the color effect in the object-naming task of Experiment 1. It was found that the effect of color in the object-naming task was correlated with the type of color responses in the Rorschach Inkblot Method. The results support an "early" cognitive account of the Determinants. We discuss implications concerning the theory of the Rorschach and the relation between emotion, personality, and cognition.

Nearly 90 years after the first publication of *Psychodiagnostics* (Rorschach, 1921), the Rorschach Inkblot Method (RIM) is still one of the most highly used and yet controversial personality tests. Most of the debate concerning the RIM has focused on its reliability, validity, and utility as a scientific assessment tool (see Meyer & Archer, 2001, for review). In this article, we focus on the theoretical basis of the RIM (see Hunsley & Bailey, 2001, for a related discussion) and seek to address the question of the mechanism underlying Determinants, a major theoretical concept in the RIM.

When administering the Rorschach, the examiner shows the examinee 10 inkblots, one by one, and asks him or her "What might this be?" The participant describes at this stage what he or she sees. After showing all the cards, the inquiry stage begins. The features of the blot that are reported to account for the perception of the blot as a certain object are called the *Determinants.* For example, if the participant reports seeing a flower in Card 8 because of the red color, we code that response as reflecting Color Determinant.

Thus, the logic of the RIM entails that the report in the inquiry stage accurately reflects the cognitive process that occurred during the initial viewing of the inkblot. This premise, although usually implicit, is so fundamental to the theoretical understanding of the response process that in the literature, the features of the inkblot and the participant's report are both called Determinants. Therefore, to understand the meaning of the Determinants, it is important to specify the cognitive processes underling it.

The most influential theoretical description of the RIM was provided by Exner (e.g., 2003). First, we briefly describe Exner's (2003) theoretical model of the response process and the role of Determinants within it. According to Exner (2003), there are six stages that determine the response process. The first stage is *visual input and encoding of the stimulus and its parts*. In this stage, "the stimulus field is scanned, encoded and held in a form of short-term storage" (Exner, 2003, p. 169). In the second stage of classification/identification, the data in the short-term storage are compared to data about objects held in long-term storage to "classify (identify) the field and/or its part" (Exner, 2003, p. 169). The comparison in this second stage is made by matching internal representations of objects to the physical features of the object (e.g., Color, Form), which Exner (2003) termed *distal features* or *critical bits.* According to Exner (2003), the processes that take place in Stage 2 lead to many potential responses, and only 25% to 35% of them are eventually delivered by the participant during a standardized administration. In fact, the next four stages are different ways of discarding potential answers (Stages 3 and 4) and selecting from the remaining responses (Stages 5 and 6). The physical features (i.e., critical bits or distal features) that cause the response are identified during the inquiry stage and are called Determinants.

In this conception, the Determinants play a role in various stages of the response process during the Rorschach administation. Yet, it is not entirely clear whether the report of the participant during the inquiry stage is based on early or later stages of this response process. We are not aware of any research to date that directly linked the report of the participant in the inquiry stages to the processes that took place during the Rorschach administration itself. The purpose of this study was to show that the Determinants assessed during the inquiry stage are directly related to online cognitive processes that preceded it during the Rorschach administration. Moreover, we show that cognitive processes at the very early stages (Stages 1 and 2)

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of the Rorschach administration phase already affect the subsequent report in the inquiry stage. More generally, we sought to demonstrate that there might be a strong relation between the Determinants that are assessed in the RIM and fundamental properties of the participant's cognitive (visual) system during object recognition.[1] To this aim we have focused on the more specific case of color determinants.

There are three types of Color Determinants. When the report is primarily based on form and color is only secondary, it is classified as a FC Determinant. When the report is primarily based on color and form is secondary, it is classified as a CF Determinant. When the report of the inkblot is exclusively based on color, it is classified as a C Determinant. The frequency of these Determinants can be used to assess the relative contribution of color to the identification process. Indeed, several measures have been invented for this purpose. In this study, we primarily use a measure called the Color Ratio. The Color Ratio is a simple summation of the number of FC Determinants versus the sum of both CF and C Determinants. Participants are assigned to the Form-Dominant category when the number of FC determinants is larger than that of the CF + C determinants. They are assigned to the Color-Dominant category when the number of CF + C determinants exceeds that of the FC determinants. They are not assigned to any group when the number of the FC determinants is equal to that of the CF + C determinants.[2]

Our main research goal was to examine whether there is a relation between color contribution to the formation of the response in the RIM (e.g., Color Determinants) and color involvement in relatively early stages of the object-recognition process that corresponds to the two early stages in Exner's (2003) model. As we discuss more extensively in the general discussion, this issue is important for at least one more reason. To the extent that the Determinants reported during the RIM indicate certain emotional predispositions, it may point to a relation between the emotional system and basic cognitive operations concerned with visual object recognition.

The exact role of color processing in object recognition is controversial (see Tanaka & Presnell, 1999, for a review). Obviously, people can watch achromatic movies without much difficulty, but it is not agreed whether the addition of color information facilitates entry-level representations of object recognition. Studies that have manipulated color during object recognition have obtained mixed results. Most studies in this domain have compared an achromatic object (a baseline condition), an object appearing in its typical color (e.g., yellow banana, the congruent condition), and an object appearing in an inappropriate color (e.g., blue banana, the incongruent condition). Color participation can be assessed by the *congruency effect* (i.e., response time in the incongruent minus response time in the congruent condition). Several studies in which participants have been asked to classify objects into two or more categories (e.g., vegetables and nonvegetables) have not demonstrated an effect of color manipulation on this classification (Biederman & Ju, 1988; Davidoff & Ostergaard, 1988; Ostergaard & Davidoff, 1985; but see Price & Humphreys, 1989). In contrast, when participants have been asked to name objects, there appears to be a consistent effect of the color manipulation (Davidoff & Ostergaard, 1988; Ostergaard & Davidoff, 1985; Price & Humphreys, 1989; Tanaka & Presnell, 1999; Wurm, Legge, Isenberg, & Luebker, 1993). These mixed findings have led to disagreements among researchers concerning the exact level of visual object processing in which color is involved. Despite this disagreement, it is widely agreed that color processing is at least essential at the representational level required for naming visual objects.

We created an object-naming task similar to that used by Price and Humphreys (1989) in which participants had to name familiar objects whose colors were manipulated. We designed Experiment 1 to examine whether the influence of color on object naming can be observed with our method. We examined the main issue, the relation between processes in the Rorschach and basic object-recognition processes, in Experiment 2 in which each participant was administered a Rorschach and was tested on the object-naming task. We hypothesized that the degree to which participants are influenced by color in the object-recognition task is correlated with the degree of color influence in the response formation during the Rorschach.

Experiment 1

The purpose of this experiment was to establish an object-naming task that is sensitive to the objects' color. As pointed out by Price and Humphreys (1989), the effect of color on object naming would be maximized if the objects in the task are structurally similar and if their color is diagnostic. To this end, all the objects in our task were vegetables and fruits (see Table 1).

Method

Participants. Participants were 15 undergraduate students with normal vision and no color blindness who participated for fulfillment of course requirement.

Stimuli and design. Photos of 10 objects, fruits and vegetables, were taken on white background and were digitally molded by a graphic artist so that only minimal three-dimensional cues were left. Each object could be achromatic, appear in a congruent color, or appear in an incongruent color (see Table 1). In the congruent condition, the object appeared in its natural color (e.g., yellow banana). Note that four of six colors used in the experiment were congruent for two objects each (e.g., the yellow color was used for both banana and lemon). This procedure ensured that participants could not rely on the color to name the object (cf. Ostergaard & Davidoff, 1985). In the incongruent

TABLE 1.—The colors used for the objects in the congruent and incongruent conditions.

	Orange	Yellow	Green	Red	Brown	Dim Purple
Congruent version	Orange Carrot	Lemon Banana	Avocado Cucumber	Tomato Chili	Potato	Eggplant
Incongruent version	Tomato Cucumber	Avocado Chili	Eggplant Carrot	Lemon Banana	Orange	Potato

[1]Exner (2003) used the terms *identification* and *classification* synonymously. These terms are not entirely synonymous in the cognitive literature. To be consistent with the cognitive literature, we use the term *object recognition,* which includes both classification and identification processes.

[2]Our main analysis is based on the Color Ratio. To make sure that this measure is not idiosyncratic, we also use other measures that we review in the Results section.

condition, each object was painted with a color associated with one of the alternative objects. In the achromatic condition, the objects were presented in a gray color. Participants named the object, and their reaction time was recorded by a Sony ECM-T6 microphone that was placed on a chin-rest and interfaced with the computer. Following the vocal response, A. Kron keyed the response into the computer for error analysis.

Participants first practiced naming two nonexperimental objects that were shown each with the three color conditions (congruent, baseline, and incongruent). They were then familiarized with the ten experimental objects listed in Table 1. In this familiarization stage, a picture of each object in each of the three experimental condition appeared together with the object's name. Participants then performed two experimental blocks. Each object was presented three times in each block, once in each of the three conditions, leading to a total of 30 trials per block. The order of the presentation of the three conditions for each object was randomized within each block.

Procedure

Each trial began with a central fixation point that was presented for 300 ms, followed by blank screen for 200 ms, followed by the appearance of a single central object that remained on the screen until the participant's response. The fixation point of the next trial was presented 1,500 ms after the response. We asked participants to name the objects as quickly as possible while minimizing their mistakes.

Results and Discussion

We calculated the reaction times (RT) of correct responses of the participants in each condition. Mean correct RTs and standard deviations in each condition are shown in Table 2. For simplicity, we averaged the results across the two blocks.

As expected, participants were strongly influenced by the color manipulation. A within-subjects focused contrast analysis with weights of –1, 0, and 1 for the congruent, achromatic, and incongruent conditions, respectively, confirmed our main hypothesis; objects in the incongruent color condition were named significantly slower than objects in the congruent color condition, whereas the achromatic version fell in between, $F(1, 14) = 20$, $p < .0005$, $r_{\text{effect size}} = .46$. The means for the three conditions are located in their expected linear order (incongruent = 946, achromatic = 883, and congruent = 818). The robust effect of color manipulation on object naming is indicative of the involvement of processes concerned with color during naming of visual objects. We can now move to the main goal of the study, namely, examining whether individual differences in the use of color during visual object recognition are related to differences in color determinants in the RIM.

TABLE 2.—Experiment 1: Means and standard deviations of reaction times as a function of the three object-naming congruency conditions crossed with two blocks.

	Block 1		Block 2		Across Blocks	
Condition	*M*	*SD*	*M*	*SD*	*M*	*SD*
Congruent	860	160	775	65	816	96
Achromatic	909	135	857	108	883	100
Incongruent	1,014	183	878	115	946	120

Note. $N = 15$.

EXPERIMENT 2

In Experiment 2, we examined the relation between color contribution to the object-naming task and the relative usage of color information during the response formation process in the RIM. To this end, we first administered the Rorschach to our participants and then they performed the very same object-naming task used in Experiment 1. The magnitude of the congruency effect in the object-naming task can be considered as a measure of the degree of color involvement in basic object-recognition processes. Our main hypothesis is that the ratio of the Color dominated Determinants in the RIM is also affected by the degree of color involvement in basic object-recognition processes. Therefore, we predicted that participants who had a higher ratio of Color-dominated Determinants in the RIM would also show a larger magnitude of congruency effect in the object-naming task.

Participants

We recruited 60 participants, students in the ninth grade[3] with normal vision, from a junior high school in Jerusalem, and they received payment for their participation.

Design and Procedure

We administered and scored each Rorschach record according to the Comprehensive System guidelines (Exner, 2003). Because we were only interested in Color responses, the inquiry phase focused exclusively on the colored cards (i.e., Cards 2, 3, 8, 9, and 10). On completion of the test, the participants performed the object-naming task used in Experiment 1. We measured interrater reliability by intraclass correlation for a random sample of two judges (A. Kron and H. Benziman) called ICC(2,2) (Shrout & Fleiss, 1979). All 60 protocols were scored by two judges. When these scores differed, we used a third judge to resolve the score. We computed this measure separately for each of the three types of Color Determinates (FC, CF, and C). The ICC(2,2) measures were, .93, .91, and .80 for FC, CF, and C, respectively. In addition, we transformed the direction of the Color Ratio FC:CF + C into a trichotomized measure in which the Color-Dominant, No Direction, and Form-Dominant classifications were coded as 3, 2, and 1, respectively. The ICC(2,2) for the trichotomized measure was .90.

Results and Discussion

As in Experiment 1, we calculated the RTs of correct responses of the participants in each condition. For simplicity, we averaged the results across the two blocks.

[3]At the time when this study was conducted (2002), the frequency of using CF and C Determinants was reported to be much lower than the frequency of FC among nonpatient adults; CF mean = 2.36, C mean = 0.08, and FC mean = 4.09 (Exner, 1995). To increase the relative number of CF and C Determinants, participants were junior high school students (with mean age of 15). Around this age, the frequency of using the CF Determinant was supposed to be considerably higher and the frequency of FC lower compared to nonpatient adults: CF mean = 2.85, C mean = 0.03, and FC mean = 3.14 (Exner, 1995). In the latest edition of the Comprehensive System (Exner & Erdberg, 2005), the mean frequency of CF + C for nonpatient adults is equal to FC. It is possible, therefore, that this study can also be conducted with adults.

TABLE 3.—Experiment 2: Means, standard deviations, skewness, and kurtosis for color determinants and reaction times of the three object-naming congruency conditions.

Condition	*M*	*SD*	Skewness	Kurtosis
Color Determinants				
FC	1.07	1.29	1.00	−0.07
CF	1.00	1.19	1.02	−0.08
C	0.25	0.65	3.04	9.55
FC – (CF + C)	−0.18	1.45	−0.11	−0.09
Object-Naming Task				
Congruent	915	188	1.28	11.68
Achromatic	992	180	1.70	4.86
Incongruent	1089	204	1.32	2.70
Congruency effect	174	156	−0.32	2.96

Note. $N = 59$.

One participant was discarded from the analysis due to a computer problem during the naming task, leaving 59 participants for our main analysis. Table 3 presents the mean, standard deviation, skewness, and kurtosis for the Color Determinants and for the three conditions of the object-naming task. As can be seen from Table 3, skewness and kurtosis of the three object-naming conditions show only moderate departure from normality (Curran, West, & Finch, 1996), justifying the use of parametric analyses. Replicating the results from Experiment 1, a within-subjects focused contrast analysis with weights of –1, 0, and 1 for the congruent, achromatic, and incongruent conditions, respectively, show that objects in the incongruent color condition were named significantly slower than objects in the congruent color condition, whereas the achromatic version fell in between, $F(1, 56) = 71.52$, $p < .0001$, $r_{\text{effect size}} = .35$.

We assigned participants into three categories on the basis of their Color Ratio direction. We assigned 18 participants who showed no direction in the Color Ratio (FC = CF + C) to the no-direction condition; we assigned 17 participants to the Form-Dominant condition (FC > CF + C); and we assigned 24 participants to the Color-Dominant condition (FC < CF + C). Table 4 presents the congruency conditions separately for the three Color Ratio groups. To demonstrate the relation between the Rorschach Color Ratio and the effect of color in the object-naming task, we examined the congruency effect (the difference between the incongruent and congruent conditions) as the dependent variable. We performed a between-group focused contrast of the Color Ratio using weights of –1, 0, and 1 for the Form-Dominant, No-direction, and Color-Dominant groups, respectively. As expected, the Form-Dominant group showed a smaller congruency effect ($M = 114$ ms) than the Color-Dominant group ($M = 236$ ms), with the no-direction congruency effect in between these two conditions ($M = 147$); $F(1, 56) = 6.64$, $p < .05$, $r_{\text{effect size}} = .33$.

TABLE 4.—Experiment 2: Means and standard deviations of reaction times as a function of the three conditions of the object-naming task crossed with three Color-Ratio conditions.

	Form Dominant FC > CF + C[a]		No Direction FC = CF + C[b]		Color Dominant FC < CF + C[c]	
Condition	*M*	*SD*	*M*	*SD*	*M*	*SD*
Congruent	865	122	961	269	916	148
Achromatic	907	103	1,046	223	1,012	173
Incongruent	979	123	1,108	168	1,153	245
Congruency effect	114	145	147	166	236	137

[a] $n = 17$. [b] $n = 18$. [c] $n = 24$.

TABLE 5.—Experiment 2: A correlation matrix of the object naming congruency effect with three Rorschach scores involving color: FC – (CF + C), the Affective Ratio (Afr), and the Weighted Sum of Color (WSumC).

Scale	WSumC	Afr	FC – (CF + C)
Afr	.19		
FC – (CF + C)	–.33*	–.01	
Congruency effect	.08	.10	–.25*

*$p < .05$.

Our hypothesis focused specifically on the relation between the congruency effect and the Color Ratio in the RIM. However, in addition to the Color Ratio, there are other measures involving the Color Determinants. To rule out the possibility that all measures of Color Determinants have a similar relation with the congruency effect, we calculated two other measures on the basis of the Color Determinants. One such measure is the Affective ratio (Afr), which compares the total number of answers to the last three cards (which are colored) with the total number of answers given to the first 7 cards (which are mostly achromatic). Note that this measure does not distinguish between Color-based and Form-based responses. A second measure is the weighted sum of C (WSumC), which is the weighted sum of color determinants (1/2FC + 1CF + 1.5C) and is usually interpreted as a measure of general usage of color determinants (see Exner, 2003, pp 314–326, for details). In addition, because in the preceding analysis we used trichotomized version of the Color Ratio, which discards information and might result in a loss of statistical power (see MacCallum, Zhang, Preacher, & Rucker, 2002; Streiner, 2002), we also calculated a third measure that is simply a transformation of the Color Ratio into a continuous scale defined as FC – (CF + C). Because these three measures have a continuous scale, we could not perform analyses of variance as before. Instead, we calculated the correlation between each of these measures and the congruency effect. In addition, we calculated the intercorrelation between the three measures. These correlations are presented in Table 5. As expected, the FC – (CF + C) index, which is based on the Color Ratio, shows a significant correlation with the congruency effect, $r = –.25$, $p < .05$. In contrast, the correlation between the other two measures, the Afr and WSumC, and the congruency effect is very small (0.10 and 0.08, respectively) and does not approach statistical significance. Interestingly, although WSumC is not correlated with the congruency effect, it does show a medium correlation with the FC – (CF + C) index, $r = –.33$, $p < .009$. One possible explanation for this dissociation is that WSumC does not compare FC to CF + C but is the weighted summation of the three Determinants. Therefore, WSumC does not reflect the relative contribution of Color to response formation but a general usage of Color Determinants. Thus, the correlation between WSumC and the FC – (CF + C) index might not share variance with the correlation of FC – (CF + C) and the congruency effect. Indeed, the correlation between FC – (CF + C) and congruency effect, $r = –0.25$, almost does not change when partialing out WSumC scores, $r = –0.23$, $p < .07$.

General Discussion

In this study, we examined the relation between the relative contribution of color to object-recognition task and to a standard Rorschach response. In Experiment 1, we established a color-naming paradigm in which the involvement of color processes during object naming can be observed. In Experiment 2, we demonstrated a clear relation between the color Congruency Effect in the object naming task and the Color Ratio in the RIM. Participants with a higher Color Dominant Color Ratio in the RIM showed higher contribution of color in the object-naming task.

As stated previously, Exner's (2003) theoretical model of the response process consists of six stages. The first 2 stages deal with identification of the percept and its matching to long-term representations of objects. Because the inkblots in the Rorschach do not portray familiar objects, multiple possible objects are identified during these two early stages. The last four stages all involve higher level processes that essentially narrow the number of responses that eventually are provided by the participant. It is important to know which of these stages affects the pattern of the participant's response in general and the Color Ratio (i.e., the relative contribution of the Color Determinant to the responses) in particular. Our study sheds light on this question. The object-recognition task used in our study reflects basic processes of object recognition and is therefore a reflection of processes that take place during the first 2 stages in Exner's (2003) model. The finding that this task correlates with the Color Ratio suggests that the latter is determined by these stages. Moreover, our study suggests that it is not necessary to use ambiguous stimuli (such as those portrayed in the inkblots) to identify the Color Ratio of participants. The object-recognition task included familiar and unambiguous objects that nevertheless correlated with the Color Ratio.

More generally, the results also support two major assumptions underlying the Rorschach. The fundamental logic of the Rorschach is that the Determinants, which are reported by the participants in the inquiry stage, reflect cognitive processes that took place during the actual administration when participants initially examined the inkblots. The participant's verbal report is the only indication of that cognitive process. Although often overlooked by researchers and clinicians, two basic assumptions underlie this logic. The first is that information given during the inquiry stage reflects the perceptual and cognitive processes that took place during the administration phase. Note that there is a time interval of around 20 min between the Rorschach administration and the inquiry stage. Levin (1953) was the first to make this assumption explicit. Levin pointed out that the participant's report in the inquiry might not reflect only the basic cognitive operations during the administration stage but might also include a "higher cognitive process," which he suggested involve a "defensive" mechanism. Several investigators (Beck, 1953; Klopfer, 1953) have referred to Levin's claim but have suggested that it might be very difficult to distinguish between such processes. The second assumption is that participants can verbally report about the cognitive operations that took place during the Rorschach administration. It is not obvious, however, that participants can report what feature of the percept caused them to yield specific responses. Our study provides support for these two assumptions because it shows that the reports of the participants during the inquiry stage are related to basic cognitive processes of object recognition.

The results might imply that the response process of the RIM is another form of an object-recognition task in which participants are asked to recognize objects in the inkblot. Within this theoretical framework, Color Determinants are the relative contribution of colors and form to this recognition. This line of thinking is appealing because it suggests that we might be able to use research paradigms and theoritical understandings from the cognitive psychology literature of object recognition to further our understanding of the Rorschach. From this perspective, it might be concluded that participants that are classified as part of the Color Dominant group have a greater tendency to use color during object recognition than those who are classified as the Form Dominant group.

Although this interpretation is consistent with the results, there are alternative intepretations as well. In particular, it is possible that our results reflect a more general process of dealing with cognitive conflicts. The incongruent condition in our study creates a conflict (between the color and the identity of the object) that needs to be resolved. Participants that have a general difficulty with cognitive conflict resolution would also be slower in this condition. As such, the congruency effect in our object-naming task can be interpreted as similar to other tasks that involve cognitive conflicts (such as the well-known Stroop [1935] task). Thus, it might be that people from the Color Dominant group do not rely more on color information but have an impaired ability to resolve cognitive conflicts, possibly due to problems in excecutive functions or cognitive control (see Posner & Rothbart,1998, for review). Future research is required to distinguish between these alternative interpretations.

Finally, our results may suggest an intriguing possibility of a relationship between cognition and emotion. The Color Ratio shows a mild relationship with behavioral criteria of impulsivity (Murray & Jackson, 1964), aggressive behavior (Finney, 1955), response inhibition (Gill, 1966), and mental disorders (Exner, 1978). Our findings, which demonstrate a relationship between the Color Ratio and visual cognitive processes, imply that there might be a relation between these basic cognitive processes and emotional behavior. That is, individual differences in processing color during object naming may be related to individual differences in impulsivity, aggressive behavior, response inhibition, or psychopathology. If so, it might be possible to identify individual differences in such emotional traits by employing a visual task such as the one used in the this study. This possible relation between the cognitive and emotional systems, as well as its possible implication for diagnosis, is currently being investigated in our laboratory.

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