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Influence of divided attention on the attraction effect in multialternative choice

Takashi Tsuzuki* Yuji Takeda† Itsuki Chiba‡

Abstract

The attraction effect in multialternative decision making reflects the context-dependent violation of rational choice axioms. This study examined the effect of concurrent divided attention in three-alternative visual choice tasks. The concurrent divided attention task is considered to consume the mental resources available for the choice task. There were three conditions: (a) the task-relevant condition, in which the auditory task should consume resources across multiple levels; (b) the task-irrelevant condition, in which the auditory stimuli should consume perceptual resources; (c) and the control condition, in which the resources should not be consumed by auditory stimuli. Thirty-three participants solved 24 hypothetical purchase problems with three alternatives that differed in terms of two attributes. The results indicated that the choice proportion of the target was significantly higher in the task-relevant condition than in the task-irrelevant and control conditions, thereby suggesting that a reduction in cognitive (and/or response) resources is critical for the attraction effect.

Keywords: attraction effect, multialternative choice, divided attention, mental resources

1 Introduction

Much-studied findings regarding the so-called context-sensitive decisions warrant specific attention as they constitute violations of axioms that were believed to be fundamental to rational choice (Rieskamp et al., 2006; Roe et al., 2001; Tsuzuki & Busemeyer, 2012; Tsuzuki & Guo, 2004; Usher & McClelland, 2004). Rational theories of decision-making

*Department of Psychology, College of Contemporary Psychology, Rikkyo University, 1-2-26 Kitano, Niiza, Saitama 352-8558, Japan. E-mail: tsuzuki@rikkyo.ac.jp. ORCID: 0000-0001-9298-9802.

†National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan. ORCID: 0000-0001-6950-087X.

‡National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan. ORCID: 0000-0001-9528-260X.

assume that choices are intrinsically determined by the utilities of individual alternatives and are thus unaffected by the relationships among the alternatives that are a part of a choice context. Studies on context effects usually utilize a three-alternative choice task, in which each alternative has two attributes (e.g., the quality and price of a consumer product). The two core alternatives (i.e., the target and competitor) form a trade-off; one is better than the other on one attribute (e.g., higher quality) but worse on the other (e.g., expensive), and the third alternative (i.e., the decoy) is added to them. It has been shown that the probability of choosing the target increases when the decoy is slightly inferior to the target on one or two attributes (e.g., the decoy has slightly poorer quality and/or is more expensive than the target) and (usually) identical on the other attribute. This is known as the "attraction effect" (Hedgcock & Rao, 2009; Huber et al., 1982, 2014). The attraction effect is one of the best-known phenomena concerning context-sensitive choices.

The total amount of available mental resources (capacity) to carry out multiple activities at the same time is limited (Kahneman, 1973). Based on this limited resource model, studies have shown that the magnitude of the attraction effect is influenced by the amount of mental resources used during the task (Dhar & Gorlin, 2013). In one study, the effect increased when a cognitive depletion task was assigned (Pocheptsova et al., 2009); the researchers reported an increase in the attraction effect when a multialternative choice task was preceded by the Stroop test or a self-regulation task, which is believed to deplete mental resources. Furthermore, Masicampo and Baumeister (2008) reported a decrease in the attraction effect when participants ingested sugar and had an increased blood glucose level, which is believed to increase mental resources. The findings of a recent study conducted using electrophysiological measures also underscore the possibility that the occurrence of the attraction effect is related to fewer mental resources being allocated to a choice task (Tsuzuki et al., 2019). The researchers reported that the N1 amplitude of event-related brain potentials elicited by task irrelevant auditory stimuli increased in the trials in which the participants chose the target (i.e., the occurrence of the attraction effect), when compared to the trials in which they chose the competitor (Tsuzuki et al., 2019). As the N1 amplitude is considered to reflect early perceptual processing, such as stimulus filtering and automatic attention shifting (Escera et al., 1998), the amount of mental resources invested in perceptual processing can affect the occurrence of the attraction effect. These findings suggest that the attraction effect increases when the mental resources available for the choice task are reduced.

In contrast, other empirical findings indicate the existence of an opposite relationship between the available mental resources and the attraction effect. In other words, a reduction in the mental resources available for allocation to a choice task can decrease the attraction effect. For example, Pettibone (2012) has reported that the magnitude of the attraction effect decreases with increases in the levels of time pressure for the amount of time taken to make a decision. Indeed, other findings also suggest that the attraction effect requires a longer deliberation time to emerge (Cataldo & Cohen, 2018; Gluth et al., 2018; Spektor et al., 2018). Furthermore, Simonson (1989) found that the attraction effect was stronger among participants who expected to justify their decisions to others. Sequential sampling models of value-based decisions of context effects predict that adequate time steps of comparisons and accumulations are imperative for the occurrence of the attraction effect (Busemeyer et al., 2018; Noguchi & Stewart, 2018; Roe et al., 2001; Trueblood et al., 2014; Usher & McClelland, 2004). These studies indicate that sufficient deliberation time is needed for the occurrence of the attraction effect; this underscores the possibility that the attraction effect may increase with increases in the availability of mental resources.

Although previous studies have demonstrated the influence of available mental resources on the attraction effect, the direction of this influence (positive or negative) remains controversial. Furthermore, the kind of mental resources that influence the processes that induce the attraction effect remain unclear, especially in view of the assumption that these resources are used across multiple levels, such as perception, cognition, and response processes (Wickens, 2008). The manipulations used in previous studies have not addressed this issue. The aim of the present study was to investigate whether the amount of available mental resources influences the magnitude of the attraction effect. In addition, if the amount of available resources positively or negatively influences the magnitude of the attraction effect, we sought to ascertain the level of mental resources required to influence it. To this end, we employed a concurrent divided attention task during the choice task. Because a concurrent divided attention task would consume the mental resources available for the choice task, we expected to find direct evidence of the relationship between mental resources and the attraction effect through this manipulation (i.e., to overcome the limitations of the manipulations used in previous studies; e.g., Pocheptsova et al., 2009; Simonson, 1989).

There were three conditions in this study: (1) a task-relevant condition, (2) a task-irrelevant condition, and (3) a control condition. In the task-relevant condition, participants were required to perform an auditory oddball task. Specifically, rare deviant stimuli (500 Hz pure tones) were embedded in a sequence of standard stimuli (1,000 Hz pure tones), and the participants were required to press a button when the deviant stimuli were presented while concurrently performing the visual choice task. We expected the concurrent oddball task to consume mental resources across multiple (i.e., perceptual, cognitive, and response) levels, because the participants had to discriminate between the auditory stimuli and respond only to the deviant stimuli. In the task-irrelevant condition, the same auditory stimuli used in the task-relevant condition were presented during the visual choice task, but the participants were instructed to ignore the auditory stimuli. Past findings indicate that rare and unexpected changes in a task-irrelevant auditory sequence will capture attention participants' in an automatic and a perceptual manner and disrupt performance on a visual task (e.g., Parmentier, 2014). In the control condition, the auditory sequence consisted of only the standard stimuli (i.e., 1,000 Hz pure tones), and the participants were instructed to ignore them during the visual choice task. Therefore, in the control condition, the auditory stimuli did not consume mental resources. If a reduction in cognitive and/or response resources is critical to the occurrence of the attraction effect, the choice proportion for the target should increase or decrease in the task-relevant condition, when compared to the other two conditions. However, if a reduction in perceptual resources also influences the occurrence of the attraction effect, the choice proportion for the target will be greater or lesser in the task-irrelevant and task-relevant conditions than that in the control condition.

2 Materials and Methods

2.1 Participants

Thirty-three students from Rikkyo University (Niiza, Saitama, Japan; mean age = 21.79 years, standard deviation = 1.45; age range = 20–26 years; 17 women, 16 men) participated in the study. All the participants reported normal or corrected-to-normal vision and normal hearing. They received 1,000 Yen (about $10 U.S.) as compensation for one hour of participation. The study was approved by the safety and ethics committees of Rikkyo University and was conducted after each participant had provided written informed consent. They were recruited from a participant pool without any restrictions. We did not conduct power analysis to determine the required sample size before collecting data. However, the number of participants ($n = 33$) included in this study is similar to the size of the sample used in our previous study (Tsuzuki et al., 2019), in which we examined the effect of attentional resources on the attraction effect using a sample of 30 participants, who were required to perform a three-alternative visual choice task.

2.2 Apparatus and Stimuli

The visual stimuli were presented on a 20-inch liquid crystal display monitor (2007FPb; Dell, Round Rock, TX, USA), and the auditory stimuli were presented binaurally via headphones (HD265; Sennheiser, Wedemark, Germany). Both the visual and auditory stimuli were controlled by the same computer with Mac OSX, MATLAB (MathWorks Inc., Natick, MA, USA), and the Psychophysics Toolbox (Brainard, 1997; Pelli, 1997).

As in previous studies (Pettibone & Wedell, 2000; Tsuzuki & Busemeyer, 2012), we conducted preliminary surveys to determine the inherent value of each attribute and subsequently developed 24 choice sets that were identical to those in the previous study (Tsuzuki et al., 2019); however, only half of the 48 items were used (i.e., each participant underwent 24 trials). Each choice set contained two core alternatives (target and competitor) and a third alternative (decoy), based on a single type of consumer product or service, all of which were described by two attributes (e.g., quality, functional capability, design, and price). Across the 24 choice sets, the average choice proportions for the target versus the competitor were not significantly different in the preliminary surveys. The decoy was created by lowering the values of both the target and competitor attributes by one-sixth of the difference between the core alternatives. As shown in the Appendix, "A" was a target when "A", "B", and "D_A"

were presented as alternatives, whereas “B” was a target when “A”, “B”, and “D_B” were presented as alternatives.

For each alternative, the name of the product or service, the two attributes, and their values were presented in a bulleted list written in black Japanese characters against a gray background. At a viewing distance of approximately 60 cm, each visual stimulus was surrounded by a colored rectangle (red, green, or blue), which subtended a horizontal visual angle of 9.5° and a vertical visual angle of 5.7°.

The 24 trials were divided into three eight-trial conditions: the task-relevant, task-irrelevant, and control conditions. As the auditory stimuli, only 1000-Hz pure tones (75 dB/SPL with a duration of 50 ms, including 10 ms rise and fall times) were repeatedly presented with a stimulus-onset asynchrony of 400–800 ms during the viewing of the alternatives in the control condition. In contrast, 500-Hz pure tones, the deviant stimulus, were also presented with the probability of 5.70% (i.e., 1000-Hz pure tones were presented with the probability of 94.3%) in the task-relevant and task-irrelevant conditions.

2.3 Procedure

Each trial began with the presentation of a fixation point for 1 s, followed by the sequential presentation of the alternatives (target, competitor, and decoy). Each alternative was displayed for 6 s with a 1 s inter-stimulus interval. The three alternatives were repeatedly presented six times for each choice set (i.e., 18 stimuli were presented in total). Figure 1 shows the time course of a single trial in this experiment. There were six permutations of the presentation order for the target, competitor, and decoy. We strictly controlled the frequencies of these six presentation orders so that they were equally counterbalanced. In each trial, the order of presentation of the three types of alternatives was the same for each of the six repetitions. Additionally, each of the rectangles surrounding the three alternatives was randomly assigned one of three colors (red, green, or blue).

For each of the six presentations of the alternatives in each choice set, the participants were required to choose one alternative that they desired to purchase by pressing the appropriate button on a gamepad. The next trial began after the participant provided a response. The participants had been informed that they would view a series of three alternative choice sets (24 consumer products) that would be repeatedly presented several times; the surrounding colored rectangles were assigned one of the three aforementioned colors. The participants were required to decide which product to buy in each set using a gamepad corresponding to the frame color of the alternative. They were also informed that the three alternatives for each choice set differed in only two features and that the other features were equivalent. Each participant did 24 trials; they took a short break in the middle of the experiment. The order of presentation of the 24 choice sets was randomized across participants.

As explained earlier, the auditory stimuli were successively presented binaurally via headphones along with the visual stimuli. The participants were asked to ignore the

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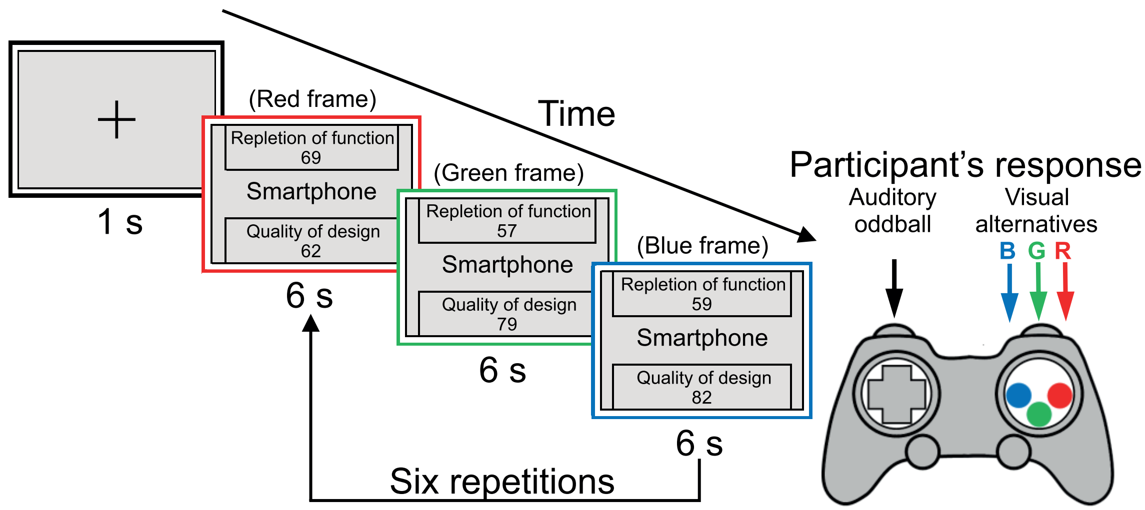

FIGURE 1: Illustration of the time course during a single trial of the dual-task experiment. The red (R), green (G), and blue (B) frames correspond to the competitor, decoy, and target, respectively.

auditory stimuli in the task-irrelevant and control conditions; in contrast, they were required to press a button as quickly and accurately as possible when the 500-Hz pure tone, the deviant stimulus, was presented in the task-relevant condition. The three conditions were randomly switched after every four trials. The participants were provided with simple instructions about the conditions before the four trials. Then, each participant did four trials of each condition (task-relevant, task-irrelevant, and control conditions) in the first half of the experiment, followed by the remaining four trials of each condition in the second half of the experiment.

3 Results

As the total number of the decoy selections was only six across a total of 792 whole trials (33 participants × 24 items), the relationship between the target and competitor selections was almost completely a trade-off. The average choice proportions (standard error [*SE*]) of the target were 0.69 (0.02), 0.59 (0.02), and 0.53 (0.03) in the task-relevant, task-irrelevant, and control conditions, respectively. The average choice proportions (*SE*) of the competitor were 0.30 (0.02), 0.40 (0.03), and 0.46 (0.03) in these three conditions, respectively. The average choice proportions (*SE*) of the decoy were 0.01 (0.01), 0.01 (0.01), and 0.01 (0.01) in these three conditions, respectively (see Figure 2).

To test the attraction effect, we used the *relative choice share of the target* (*RST*; Berkowitsch et al., 2014; Spektor et al., 2018; Trueblood et al., 2014). To calculate the *RST*, we divided the proportion of target *Pr*(T) by the sum of *Pr* (T) and the proportion of competitor choice *Pr*(C); *Pr*(T) and *Pr*(C) represent the proportion of target and competitor choice, respectively. *RST* values range from 0 to 1 (i.e., from always competitor chosen to

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always target chosen), and $RST \leq .50$ indicates an absence of the attraction effect and $RST >$ .50 indicates the presence of the attraction effect. *RST* can control for different proportions of decoy choices across different conditions. The *RST* values were 0.695 for the task-relevant condidion, 0.600 for task-irrelevant, and .537 for control. By a simple paird *t*-test, the *RST* for task-relevant was significantly higher than the *RST* for task-irrelevant ($t_{32} = 2.93$, $p = .006$) but the task-irrelevant *RST* was not significantly higher than the control *RST* ($t_{32} = 1.51$, $p = .141$). Thus, most of the effect of divided attention was in its effect on capacity, as opposed to perceptual resources.

We did some additional analysis. The Friedman nonparametric repeated measures analysis of variance of ranks for the *RST* revealed a significant effect for condition ($\chi^2 = 11.57$, $df = 2$, $p = .003$, $r = .59$). The post-hoc power analysis $(1 - \beta)$ conducted using G*Power 3.1.9.7 (Faul et al., 2007) substituted with the parametric repeated measures analysis of variance yielded a value of .949 for a large effect size (where $\eta_p^2 = .14, f = .403$, $\alpha = .05$, and the correlation coefficient among repeated measures = 0; Cohen, 1988); the result was not sufficient for a medium effect size ($(1-\beta) = .586$, where $\eta_p^2 = .06, f = .253$, $\alpha =$ .05, and the correlation coefficient among repeated measures = 0).[1] Further, we performed a Bayesian repeated measures analysis of variance using JASP 0.14.1 (JASP Team, 2020). We used the multivariate Cauchy distribution as the prior probability distribution (scale fixed effects $r = .50$, scale random effects $r = 1.00$), which was the default setting of JASP. The results showed that the main effect BF_{M} was 310.467, and the results of the multiple comparisons showed that the *RST* was higher in the task-relevant condition than in the task-irrelevant and control conditions ($BF_{10} = 6.49$, $BF_{10} = 100.11$), but no difference was observed between the task-irrelevant and control conditions ($BF_{10} = 0.52$).[2]

Moreover, the post-hoc Wilcoxon signed-rank tests with Bonferroni correction revealed that the *RST* was significantly higher in the task-relevant condition than in the task-irrelevant and control conditions ($p = .021$, $r = .47$; $p = .003$, $r = .55$). No significant difference was observed between the task-irrelevant and control conditions ($p = .53$, $r = .23$). The post-hoc power analysis $(1 - \beta)$ conducted using G*Power for Wilcoxon signed-rank tests (matched pairs) yielded a value of .997 for a large effect size (where $d = .80$, $\alpha = .05$) and .864 for a medium effect size (where $d = .50$, $\alpha = .05$).

The results of the paired Wilcoxon signed-rank tests between the *RST* and the base *RST* value (.50), which indicate the occurrence of the attraction effect, showed that the former was significantly higher than the latter in the task-relevant and task-irrelevant conditions ($p = .000$, $r = .79$; $p = .003$, $r = .58$). However, the difference was not significant in the control condition ($p = .597$, $r = .22$).

[1]This result of the power analysis using G*Power with the parametric repeated measures analysis of variance shows the upper bound for the Friedman test. Based on the results of the computer simulation, Zimmerman and Zumbo (1993) reported that the results of the power analysis were slightly lower in the nonparametric Friedman test than in the parametric repeated measures analysis of variance.

[2]The multiple comparisons were based on a *t*-test with a Cauchy (0, $r = 1/\mathrm{sqrt}(2)$) prior distribution, which was the default setting of JASP.

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In the task-relevant condition, the average (standard error [*SE*]) hit rate, false alarm rate, and *d'* on the auditory oddball task were 0.93 (0.02), 0.0009 (0.0002), and 4.86 (0.14), respectively. In this condition, the average reaction time (standard error [*SE*]) for the hit and false alarm was 1.04 (0.02) and 1.66 (0.03) seconds, respectively. The correlations between performance (*d'* on the oddball task and the *RST* in the task-relevant and task-irrelevant conditions were not significant ($r = .12$, $df = 31$, $p = .51$; $r = .15$, $df = 31$, $p = .40$, respectively).

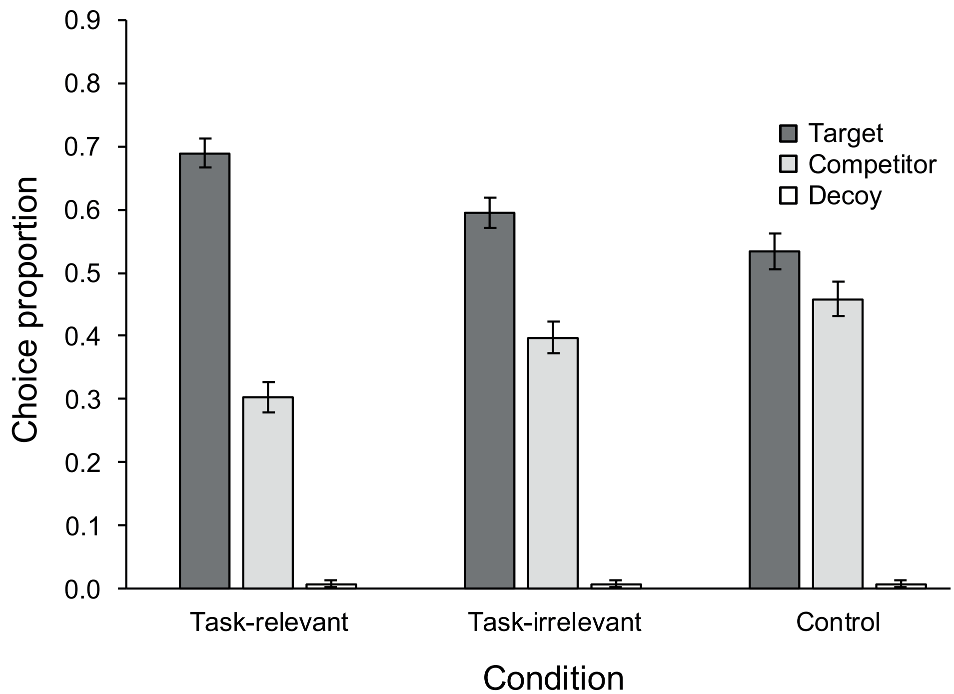

Figure 2: Mean choice proportions for the target, competitor, and decoy in each condition. Error bars indicate the standard error for the mean.

4 Discussion

This study aimed to investigate the influence of the concurrent divided attention task during the three-alternative visual choice task in terms of the occurrence of the attraction effect. As mentioned in the introduction, past findings underscore the influence of available mental resources on the attraction effect, but the direction of this influence (positive or negative) remains controversial. Some studies have found that the consumption of mental resources available for allocation to a choice task increases the attraction effect (e.g., Pocheptsova et al., 2009), but other findings suggest that the allocation of more mental resources increases the attraction effect (e.g., Simonson, 1989). The concurrent divided attention task is believed to consume the mental resources available for allocation to the choice task; thus, it can

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provide direct evidence of the relationship between mental resources and the attraction effect. In this study, there were three conditions. In the task-relevant condition, the auditory oddball task consumed mental resources across multiple (i.e., perceptual, cognitive, and response) levels. In the task-irrelevant condition, the auditory oddball stimuli consumed perceptual resources. In the control condition, the mental resources were not consumed by the auditory (standard) stimuli. The results indicated that the choice proportion of the target was significantly higher in the task-relevant condition than in the task-irrelevant and control conditions. This suggests that the reduction of mental resources increases, rather than decreases, the attraction effect. Furthermore, these findings suggest that a reduction in cognitive and/or response resources rather than in perceptual resources is critical for the occurrence of the attraction effect.

In contradiction to the predictions yielded by the time pressure (Pettibone, 2012) and justification studies (Simonson, 1989), why did the reduction of mental resources increase rather than decrease the attraction effect? Based on eye-tracking study findings, Glaholt and Reingold (2011) have argued that the decision-making process consists of the initial screening stages, evaluation and comparison stage, and validation stage (Tsuzuki & Chiba, 2019). Although speculative, the manipulation of time pressure in Pettibone's (2012) study may not have allowed participants to fully process information about the alternatives in the choice task, apart from whether the amount of mental resources was decreased by a reduction in processing time. With regard to the effect of justification, Simonson (1989) has reported that the attraction effect is stronger among consumers who expect to be evaluated by others. It is possible that the instruction of justification modulated some kind of mental set but did not directly increase mental resources allocated to the evaluation of the alternatives of the choice set. Further investigation is needed to clarify this issue.

In this study, there was no significant difference in the choice proportion of the target between the task-irrelevant and control conditions. However, careful validation is needed. This result is inconsistent with past findings, which suggest that brain activity related to perceptual processing (i.e., the N1 component of event-related brain potentials) is associated with the occurrence of the attraction effect (Tsuzuki et al., 2019). One possible explanation for this inconsistency is that the modulation of the N1 amplitude reflected not only perceptual processing but also cognitive processing. Drawing upon the early selection model of attention (e.g., Lavie & Tsal, 1994), it can be argued that perceptually attended stimuli (eliciting a larger N1 component) are likely to be processed successively at the cognitive level. If so, the association between the N1 amplitude and the attraction effect is attributable to the influence of not only perceptual processes but also cognitive processes. Another possible explanation is that the statistical power of the present study may have been too low to detect statistical differences between the task-irrelevant and control conditions. Indeed, the average *RST* was slightly higher in the task-irrelevant condition (0.59) than in the control condition (0.53). The mean difference between task-irrelevant and control conditions is almost half of the mean difference betwen the task-relevant and control conditions. Although the difference between the task-irrelevant and control conditions is unclear, the present study showed that the average *RST* was significantly higher in the task-relevant condition than in the task-irrelevant condition. This clearly indicates that the consumption of mental resources at the cognitive and/or response levels (when compared to the perceptual level) greatly affects the occurrence of the attraction effect.

Previous studies have examined the association between mental resources and the attraction effect by manipulating the response time of the decision or by administering a cognitive depletion task before the choice task (Masicampo & Baumeister, 2008; Pettibone, 2012; Pocheptsova et al., 2009). Because such manipulations affect mental resources throughout the performance of the choice task, it is difficult to examine how and when mental resources allocated to the choice task influence the attraction effect. The concurrent divided attention task paradigm used in this study can reveal the association between the allocation of mental resources and occurrence of the attraction effect, because the timing of the presentation of auditory stimuli is a controllable variable.

Some limitations of the present study should be acknowledged. First, because the participants were asked to choose between sequentially and repeatedly presented alternatives, it was difficult to address the role of decision time, which, as mentioned in the introduction, has often been discussed in the literature (sequential sampling models; Gluth et al., 2018; Pettibone, 2012). Second, the extent to which the mere presentation of oddball stimuli in the task-irrelevant condition imposed a perceptual load remains unclear because the oddball stimuli and choice task targeted different sensory modalities (i.e., auditory versus visual presentations). To investigate the influence of perceptual load on the attraction effect in greater detail, future studies should focus on the same sensory modality.

In real-world purchase contexts, consumers receive several kinds of cross-modal information similar to what the participants experienced in the present experiment. Therefore, it is necessary to consider cognitive resource allocation for cross-modal information to fully understand the properties of the attraction effect. This is related to the importance of considering external validity, which refers to the possibility of generalizing an observed causal relationship to and across different measures, persons, settings, and times (Calder et al., 1982). From the perspective of realistic consumer research, Lichters et al. (2015) have offered seven guidelines to ensure external validity in the implementation of three kinds of choice-context-effect (including the attraction effect) experiments. They are as follows: (1) introduce real economic consequences, (2) use real items or realistic attributes and attribute levels in descriptions, (3) align the products/services with the target audience in the real-world application, (4) allow for a sensory pre-choice product evaluation, (5) include a no-buy option, (6) control for subjects' perception, and (7) avoid learning processes in repeated choices. Laboratory studies have not sufficiently adhered to some of these guidelines. The present experiment adhered to most of them but did not comply with the fourth and fifth guidelines. Therefore, future studies should systematically address these issues to enhance external validity.

In sum, this study investigated the association between multilevel mental resources and attraction effect in a visual multialternative choice task. To this end, the concurrent divided attention task was used to reduce the mental resources available for the choice task. The results indicate that a reduction in cognitive and/or response mental resources are critical for the occurrence of the attraction effect.

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Appendix: The three-alternative choice sets used in the experiment.

Consumer product or service	Two attributes	A	B	D_A	D_B
Athletic shoes	Quality of design (1–100)	77	62	75	60
	Comfort in wearing (1–100)	67	77	65	75
School bag	Weight (kg)	0.70	1.10	0.77	1.17
	Quality of design (1–100)	63	78	61	76
Traveler's bag	Quality of design (1–100)	78	63	76	61
	Weight (kg)	1.10	0.70	1.17	0.77
Coat	Quality of design (1–100)	68	78	66	76
	Price (1000 yen)	6.4	9.4	6.9	9.9
Exercise clothes	Price (1000 yen)	9.4	6.4	9.9	6.9
	Quality of design (1–100)	78	68	76	66
Wristwatch	Quality of design (1–100)	82	72	80	70
	Price (1000 yen)	9.80	5.80	10.47	6.47
MP3 Player	Price (1000 yen)	10.70	6.70	11.37	7.37
	Sound quality (1–100)	74	68	73	67
Earphones	Sound quality (1–100)	82	68	80	66
	Price (1000 yen)	3.80	2.80	3.97	2.97
Electronic dictionary	Repletion of dictionaries (1–100)	77	67	75	65
	Price (1000 yen)	21.0	16.0	21.8	16.8
Digital camera	Image quality (1–100)	72	78	71	77
	Repletion of functions (1–100)	75	60	73	58
Smartphone	Repletion of functions (1–100)	59	69	57	67
	Quality of design (1–100)	82	62	79	59
Notebook computer	Repletion of functions (1–100)	67	77	65	75
	Price (1000 yen)	66	96	71	101
Tablet personal computer	Price (1000 yen)	16.0	21.0	16.8	21.8
	Repletion of functions (1–100)	67	77	61	71
Electronic keyboard	Number of distinctive functions	14	8	13	7
	Sound quality (1–100)	68	78	66	76
Liquid crystal display television	Screen size (inch)	20	27	19	26
	Image quality (1–100)	78	68	76	66
Single sofa	Price (1000 yen)	13.20	9.20	13.87	9.87
	Seating comfort (1–100)	73	63	71	61
Office chair	Seating comfort (1–100)	63	73	61	71
	Price (1000 yen)	9.20	13.20	9.87	13.87
Bed	Quality of design (1–100)	62	81	59	78
	Price (1000 yen)	17.7	24.7	18.9	25.9
Bicycle	Price (1000 yen)	21.0	16.0	21.8	16.8
	Quality of design (1–100)	72	62	70	60
Gas scooter	Quality of design (1–100)	77	62	75	60
	Gas mileage (km per liter)	59	69	57	67
Hair salon	Magazine's rating of skill (1–100)	78	68	76	66
	Time taken to reach the salon from home (min)	33	15	36	18
Fitness club	Repletion of equipment (1–100)	78	63	76	61
	Time taken to reach the club from home (min)	26	13	28	15
Rental apartment	Monthly rent (1000 yen)	53.9	58.9	54.7	59.7
	Walking distance from the station to the apartment (min)	21	12	23	14
Restaurant	Magazine's rating of skill (1–100)	73	63	71	61
	Time taken to reach the restaurant from school (min)	17	8	18	9

Note: The choice set consisted of 24 consumer products or services, their two attributes, and three alternatives (the target, competitor, and decoy), which also had two attribute values. "A" was the target when "A", "B", and "D_A" were presented as alternatives, whereas "B" was the target when "A", "B", and "D_B" were presented as alternatives.

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