

The impact of purchase quantity on the compromise effect: The balance heuristic

Yin-Hui Cheng* Shin-Shin Chang† Shih-Chieh Chuang‡ Ming-Wei Yu§

Abstract

Most prior research on the compromise effect has focused on single rather than multiple choices. This research investigates the potential effects of purchase quantity on the compromise effect. We propose that the share of the middle option in a trinary choice set decreases as the purchase quantity increases, because people tend to employ a balance heuristic to distribute their multiple choices among the available options to achieve a balanced state and to satisfy their variety-seeking tendency. Furthermore, we propose that the need for justification and an optimal stimulation level moderate the relationship between the number of purchase items and the compromise effect. These proposed hypotheses are supported by results from three experiments.

Keywords: compromise effect, purchase quantity, justification, balance heuristic.

1 Introduction

Consumers are motivated to minimize expected losses and to resolve decision conflicts in their decision-making process (Chernev, 2008; Choi, Kim, Choi, & Yi, 2006; Kahneman & Snell, 1990; Read & Loewenstein, 1995; Sheng, Parker, & Nakamoto, 2005; Simonson, 1990). When it comes to making a choice, consumers tend to avoid extreme options that are attractive in some ways but unattractive in others (Chernev, 2004; Murali, Bockenholt, & Laroche, 2007; Simonson & Tversky, 1992). Rather, they are more likely to choose a middle option, because it may be seen as the least extreme choice. This choice strategy prevents consumers from having to give up any favorable attributes of the other products (Drolet, Luce, & Simonson, 2009; Sheng et al., 2005). Consumers can justify this decision easily by arguing that the chosen product combines the attributes of the other two (Drolet et al., 2008; Murali et al., 2007; Sheng et al., 2005). Accordingly, a compromise effect occurs when the likelihood that one option will be chosen over its alternative is enhanced by the introduction of a third option, which makes first option appear as the middle option (Simonson, 1989; Dhar & Simonson, 2003). The concept of the compromise effect has been shown to be theoretically and practically robust in many fields, including business-to-

business (Dhar, Menon, & Maach, 2004; Kivetz, Netzer, & Srinivasan, 2004), group decision making (Dhar et al., 2004; Kivetz et al., 2004), technology markets (Kivetz et al., 2004), and culture difference (Briley, Morris, & Simonson, 2000).

Most prior research on the compromise effect has focused on the choice of a single unit during the purchase of a specific product and has largely ignored multiple-unit purchase decisions. Yet consumers often purchase multiple units in a product category on a single occasion. For instance, they may buy several bottles of orange juice at once. Given a choice among three available brands of juice—A, B, and C, which have high trade-off attributes—and assuming that Brand B is the middle option, will the purchase quantity change their choice behavior in favor of the middle option? Specifically, will they buy the middle/compromise option as predicted by compromise effect theory, or will they purchase every available option? As the purchase quantity increases, consumers may find that choosing only one option for multiple units may ironically heighten the decision risk instead of reducing it; therefore, they may forfeit their choice of the compromise option in favor of a strategy of diversification.

One distinct aspect of purchasing multiple units with several available alternatives is that it enables consumers to distribute their choices among different options. The distributability of choices among several options allows consumers to diversify associated risks and to obtain satisfaction from buying a variety of options. People, as predicted by balance theory (Heider, 1958), are apt to achieve a state of balance, order, and harmony in their lives. Distributing multiple units among all alternatives helps people reach a balanced state and also facilitates the

*Taichung University of Education, Taiwan. Email: yin-hui77@gmail.com.

†Corresponding author. Department of Business Administration, Chung Yuan Christian University, 200, Chung Pei Rd., Chung Li, Taiwan. E-mail: sschang351@cycu.edu.tw.

‡Chung Cheng University, Taiwan. Email: bmascc@ccu.edu.tw

§Chung Cheng University, Taiwan. Email: angelically-heart@gmail.com.

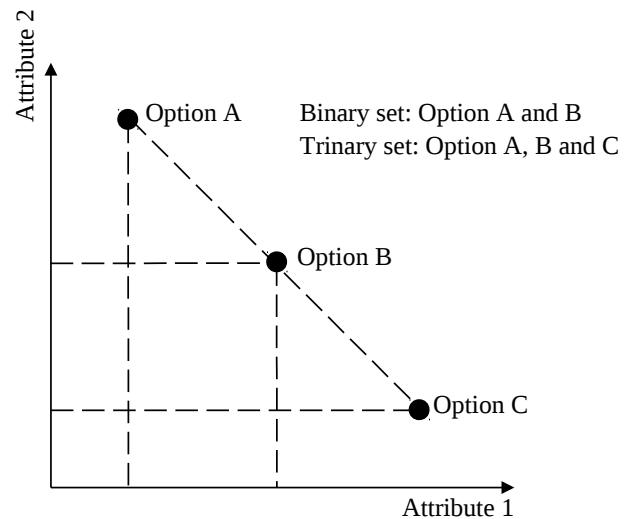
diversification of the decision risk. Hence, the compromise effect may be different for a multiple-unit purchase than for a single-unit purchase.

Moreover, multiplicity in the available options offers consumers an opportunity to demonstrate their variety-seeking tendency, which is a person's inherent preference for variety and novelty (Chernev, 2008; Kahneman & Snell, 1990; March, 1978; Payne, Bettman, & Johnson, 1988; Read & Loewenstein, 1995; Sela, Berger, & Liu, 2008; Simonson, 1990). The variety-seeking tendency may emerge when people need to minimize expected losses (Choi et al., 2006; Kahneman & Snell, 1990; Simonson, 1990), to resolve decision conflicts (Chernev, 2008; Read & Loewenstein, 1995; Sheng et al., 2005; Simonson, 1990), and to save their efforts (Chernev, 2008; Payne et al., 1988). Since the variety-seeking tendency induces people to assign their choice of multiple units among the available alternatives, it may weaken the compromise effect. Past research has suggested that the purchase quantity may affect the compromise effect, because people may prefer to make choices to minimize losses and resolve inner conflicts when making multiple choice decisions (Chernev, 2008; Simonson, 1990).

Consumers sometimes need to provide reasons for their choices. The need for justification is assumed to exercise a positive influence on the compromise effect, because the focus of the decision shifts from a choice of good options to choice of good reason for selecting that option. The compromise option seems logical when purchasing a single unit, but it may not seem plausible for choosing only the compromise alternative for all of the multiple units. Hence, having to make several choices among multiple options weakens or offsets the positive impact of decision justification. Finally, the availability of a variety of alternatives is advantageous to consumers' choices as far as their optimal stimulation level (OSL) is concerned. OSL refers to the level of stimulation that consumers want to reach in response to environmental stimuli (Leuba, 1955; Raju, 1980). When the stimulation received from diversity, novelty, ambiguity, or complexity is below the optimal level, people attempt to increase the stimulation; when it is above the optimal level, they are inclined to reduce it. Therefore, if choosing the compromise option for all multiple units cannot provide enough stimulation for consumers, they may allocate some of the purchased units to alternatives other than the compromise one.

In sum, this study explores how purchase quantity affects the compromise effect. We hypothesize that the compromise effect is dampened when the purchase quantity increases, particularly when people attempt to justify their choices. Furthermore, we suggest that the impact of the compromise effect is mediated by the balance tendency, which is computed with a formula of balance in-

Figure 1: Illustration of the compromise effect.



dex derived from the concept of balance deviation. Finally, we examine how that impact might be different for consumers with high and low OSLs, because these two types of consumers might have different tolerances to stimuli.

1.1 The compromise effect

Whenever consumers have difficulty making choices based on value maximization alone, choice is heuristic, which means it is based on consumer behaviors that eliminate uncertainty (Chernev, 2005; Sheng et al., 2005; Simonson & Tversky, 1992). The compromise effect was first introduced by Simonson (1989) to explain this kind of consumer behavior. When adding an extreme option to the original choice set of two alternatives, consumer preferences will shift to the middle option. Simonson (1989) proposed that an alternative would tend to gain market share when it became the compromise or middle option in the set. He suggested that a brand in a two-alternative set (binary set) could gain market share following the addition of an adjacent brand (trinary set) that made the initial brand a compromise choice within the set. The essence of the compromise effect is choosing the compromise or middle option in the choice set.

Figure 1 illustrates a binary set {A, B} with a trade-off between Attributes 1 and 2. After adding Option C to form a trinary set {A, B, C}, more consumers are likely to avoid any extreme options that are very attractive in some attribute dimensions but very unattractive in others (Chernev, 2004; Mourali et al., 2007; Simonson & Tversky, 1992). They tend to choose Option B to reduce inner conflicts and to minimize expected losses (Sheng et al., 2005). Choosing the middle option could resolve the

decision conflict associated with giving up any attributes from the other products. They can justify this choice by arguing that it combines attributes from both products (Drolet et al., 2009; Mourali et al., 2007; Sheng et al., 2005).

1.2 Variety-seeking and purchase quantity goals

The literature on variety seeking suggests that people generally prefer an experience that fulfills their desire for variety, novelty, change, and complexity. This desire has been summarized into two motivating factors. The first is an individual's inherent need for novelty, change, and complexity (Chernev, 2008; Kahneman & Snell, 1990; March, 1978; Simonson, 1990); the second is the notion of satiation. Prior research has suggested that the variety-seeking tendency could minimize expected losses and maximize satisfaction (Choi et al., 2006; Kahneman & Snell, 1990; Simonson, 1990). It may also resolve decision conflicts and save time and effort (Read & Loewenstein, 1995; Sheng et al., 2005; Simonson, 1990). Accordingly, the variety-seeking tendency can trigger a change in behavior and a diminishing value of repeating the original behavior (Chernev, 2008; Kahneman & Snell, 1990; March, 1978; Payne et al., 1988; Read & Loewenstein, 1995; Sela et al., 2008; Simonson, 1990). For instance, when choosing an ice cream flavor, consumers may show a preference for vanilla. The next time that they choose ice cream, however, they might try to satisfy their need for novelty, change, uncertainty, conflict, and complexity by choosing a different flavor, such as chocolate or strawberry.

When consumers' goal is to buy multiple items in a product category, they may engage in either sequential buying/sequential consumption or simultaneous buying/sequential consumption. When consumers adopt the latter strategy, which is characterized by the temporal separation of the decisions involved in buying and consuming, they may anticipate failures in accurately predicting their future preferences and thereby demonstrate more variety-seeking behaviors (Simonson, 1990). The anticipation of future dissatisfaction may explain why people possess a variety-seeking tendency (Choi et al., 2006). As a result, as the number of items to be purchased increases, people's variety-seeking tendency may induce them to distribute their choices among several options instead of only one option. In sum, as the quantity of items to be purchased increases, the variety-seeking tendency may drive people not to select one option, but to distribute their choices among several options instead. Consequently, people facing a trinary choice set containing a middle option may lower their tendency to choose the compromise option.

1.3 Balance tendency as a decision heuristic under multiple item purchase situations

Research into variety-seeking behavior has revealed that, when consumers intend to purchase multiple items and they are presented with several options in a product class, those with a stronger variety-seeking tendency tend to choose a greater number of options. Another explanation for this tendency is the concept of the quantity-matching heuristic (Chernev, 2008). It argues that consumers who are uncertain about their future preferences are more likely to simplify their decision-making process by eliminating the trade off between costs and benefits; therefore, they are more inclined to choose an assortment of items, in which the number of available options matches the planned purchase quantity. According to the quantity-matching heuristic, a consumer who plans to buy three chocolate bars is more likely to buy from a store offering three than a store offering four options.

We suggest here that consumers who intend to purchase multiple units of a product choose a greater number of options not only because of the variety-seeking tendency and quantity-matching heuristic, but also because they want to achieve a balanced state. Balance theory suggests that people desire to pursue a state of balance, order, and harmony in their lives (Heider, 1958). Spreading out the purchased items among the available options may be regarded as an efficient way to maintain a balanced state. Additionally, a greater degree of distribution among several options may function as a kind of risk dispersion, which is crucial as far as the possibility of preference change is concerned. Therefore, the balance tendency is a heuristic that facilitates the decision-making process and the reduction of risks. If the purchase quantity is relatively large, consumers will likely allocate the same number of purchased items to each available option to approach equilibrium. Based on this notion, as the purchase quantity increases, people may be less willing to buy the middle option for all of these items, which would lead to a less balanced state and escalate the associated risks. Therefore, this study proposes the following alternative hypotheses:

H1a: The compromise effect will be weaker for a large purchase quantity than for a small purchase quantity.

H1b: There will be no difference in the compromise effect between a large purchase quantity and a small purchase quantity.

2 Study 1

We conducted two experiments—referred to as Experiment 1A and Experiment 1B—to test the impact of the

Table 1: The compromise effect under the goal of purchase quantity of buying 1 bottle and buying 6 bottles for immediate use and for future use

Experiment	Buying 1 bottle			Buying 6 bottles			$(\Delta P_{B6} - \Delta P_{B1})$
	Binary $P(B; A)$	Trinary $P_C(B; A)$	$\Delta P_{B1} (\%)$	Binary $P(B; A)$	Trinary $P_C(B; A)$	$\Delta P_{B6} (\%)$	
1A (Immediate use)	41%	70%	29%	50%	52%	2%	27%
1B (Future use)	41%	79%	38%	49%	57%	8%	30%

purchase quantity for immediate consumption and for future consumption, respectively, on the compromise effect.

2.1 Experiment 1A

152 undergraduate and graduate students participated in the experiment. There were 86 female students (56.58%) and 66 male students (43.42%). The average age of the students was 21.21 years.

This experiment was a 2 (a purchase quantity of either one or six items simultaneously) \times 2 (either binary or trinary options within the choice set) between-subjects design. The subjects were randomly assigned to one of four conditions. The binary choice set consisted of Brand A and Brand B; the trinary choice set consisted of Brands A, B, and C, with Brands A and C located the same distance from the middle option, Brand B, to reduce the substitution effect (Simonson & Tversky, 1992). The shares of Brand B relative to Brand A in trinary and binary sets were calculated.

Subjects were asked to imagine going into a store to purchase six bottles (one bottle) of orange juice. In accordance with prior research, the prices and content capacity of each brand were set equally to avoid potential inferences (Chernev, 2004; Sheng et al., 2005). Each of the three (two) brands of orange juice contained 500 ml and cost \$3. However, vitamin C, fiber content, and other attributes varied among the brands (see Appendix 1). There were four scenarios corresponding to each of the four situations of buying orange juice for immediate consumption: buying one bottle of orange juice from the binary set {Brand A, Brand B}; buying one bottle from the trinary set {Brand A, Brand B, and Brand C}; buying six bottles from the binary set; and buying six bottles from the trinary set. Subjects were asked to follow the instructions and imagine the situation based on their own decision-making experiences in real-life situations. This basic scenario was pretested on 16 subjects with highly significant results.

2.2 Results

We coded the data as 2 (the purchase of 1 bottle = 0; the purchase of 6 bottles = 1) \times 2 (binary choice set = 0; trinary choice set = 1) \times 2 (the selection of Brand A = 0; the selection of Brand B = 1). The compromise effect ΔP_B was measured by $P_C(B; A) - P(B; A)$, with $P_C(B; A)$ denoting the relative share of Brand B in the trinary set and $P(B; A)$ denoting the relative share of Brand B in the binary set (Chernev, 2004; Murali et al., 2007; Simonson & Tversky, 1992). To examine H1a and H1b, we compared the $P_C(B; A)$ of buying one bottle and the $P_C(B; A)$ of buying six bottles for simultaneous consumption to determine whether there was a significant difference in the compromise effect between the different purchase quantities.

Table 1 showed that the relative share of Brand B (the compromise/middle option) associated with the purchase of one bottle increased by 29% ($\chi^2 = 5.83, p < .01$), but only increased by 2% ($\chi^2 = .23, p > .1$) with the purchase of six bottles, resulting in a difference of 23% ($\chi^2 = 4.08, p < .05$). This result indicated that the purchase quantity negatively influenced the compromise effect. Hence, H1b was rejected, and H1a was accepted. The results detailed in Appendix 2 showed the proportion of each alternative being selected.

2.2.1 Discussion

The findings from Experiment 1A demonstrated that, when consumers buy products for immediate consumption, the compromise effect for a large purchase quantity is weaker than that for a small purchase quantity, which supports H1a. When consumers purchase multiple items from a product class, prior research highlights two strategies: simultaneous choices/sequential consumption and sequential choices/sequential consumption (Simonson, 1990). When adopting the consumption strategy of simultaneous choices/sequential consumption, consumers face the possibility of a change in future preference. This uncertainty operating in this strategy leads consumers to yield more variety seeking tendency than when they employ the strategy of sequential choices/sequential con-

sumption (Simonson, 1990). Therefore, it seems worthwhile to test hypotheses H1a and H1b with regard to decisions involving the purchase of multiple items of products simultaneously for future consumption, to see whether the uncertainty associated with future preferences affects the relationship between the purchase quantity and the compromise effect.

2.3 Experiment 1B

When consumers purchase multiple items simultaneously, they may intend to consume some of them in the future. Therefore, they may feel obligated to predict their future preferences (Kahneman & Snell, 1990; March, 1978; Simonson, 1990). Will predicting future preferences alter the validity of H1a, which is supported by Experiment 1A? Experiment 1B was designed to test H1a and H1b with respect to purchases for future consumption.

In total, 136 undergraduate and graduate students participated in the experiment. There were 77 female students (56.62%) and 59 male students (43.38%). The average age of the students was 20.67 years. This experiment was a 2 (a purchase quantity of either one or six items simultaneously) $\times 2$ (either binary or trinary options in the choice set) between-subjects design, which was similar to Experiment 1A. Subjects assigned to the condition in which they were required to buy six bottles of orange juice were told to imagine that they would be consuming one bottle of orange juice per day for the following six days. They were then asked to fill out their preferred options for each day. Subjects assigned to the situation in which they were required to buy one item were asked to purchase one bottle of orange juice for consumption the following day.

2.3.1 Results

The results of Experiment 1B were shown in Table 1. The results indicated that the relative share of Brand B (the compromise/middle option) increased by 38% ($\chi^2 = 9.76$, $p < .005$) when subjects were required to buy one bottle for future consumption, but it increased only by 8% ($\chi^2 = 2.3$, $p > .1$) when they were asked to purchase six bottles for future consumption, resulting in a decrease of 30% ($\chi^2 = 5.32$, $p < .05$). The purchase quantity for future consumption negatively influenced the compromise effect. Hence, H1b was rejected and H1a was supported. The results detailed in Appendix 2 also show the proportion of each alternative being selected.

2.3.2 Discussion

Results from both Experiment 1A and Experiment 1B supported H1a, which indicated the impact of the pur-

chase quantity on the compromise effect remains unaffected when the product items are purchased for immediate and for future consumption. Prior research has shown that asking consumers to provide reasons for their choices tends to increase the compromise effect (Mourali et al., 2007; Sheng et al., 2005; Simonson, 1989). Hence, the notion that the compromise effect as stated in H1a and H1b may be different for situations in which consumers either need or do not need to justify their choices in purchasing either one or six bottles of orange juice for future consumption required further investigation.

3 Study 2

When purchasing one item of a product, consumers tend to choose the middle or compromise option, which resolves the decision conflict associated with sacrificing one attribute for another. This compromise effect may be enhanced when consumers need to justify their choices, because choosing the middle option could be justified by arguing that it combines attributes (Drolet et al., 2009; Mourali et al., 2007; Sheng et al., 2005; Simonson, 1989). If consumers plan to buy multiple items of a product, some of the purchased items may be intended not for immediate consumption but for future use. Therefore, consumers may anticipate the possibility that their preference will change in the future. When they choose multiples items from a trinary choice set, a choice other than the middle option is justified by the fact that it accommodates the uncertainty associated with a future preference change. Accordingly, the need to justify choices, when compared with no need to justify them, may increase difference between the purchase of one item and the purchase of multiple items in the compromise effect. This study proposes the following hypotheses:

H2a: The difference in the compromise effect for large and small purchase quantities with justification should be greater than that without justification.

H2b: The difference in the compromise effect for large and small purchase quantities with justification is equal to that without justification.

3.1 Experiment 2

Experiment 2 tested hypotheses H2a and H2b. In total, 360 undergraduate and graduate students participated in the experiment. There were 200 females (55.56%) and 160 males (44.44%). The average age was 19.74 years. The experiment was a 2 (with or without justification) $\times 2$ (a purchase quantity of either one or six items for future consumption) $\times 2$ (either binary or trinary options in the choice set) between-subjects design. The subjects were randomly assigned to one of eight conditions.

Table 2: Compromise effect under no-justification/justification condition.

Without justification		
Buying 1 bottle	Binary P(B;A)	44%
	Trinary B(Pc;A)	72%
	Δ PB1 (%)	28%
Buying 6 bottles	Binary P(B;A)	45%
	Trinary Pc(B;A)	53%
	Δ PB1 (%)	8%
	J_0	20%
With justification		
Buying 1 bottle	Binary P(B;A)	33%
	Trinary Pc(B;A)	82%
	Δ PB1 (%)	49%
Buying 6 bottles	Binary P(B;A)	51%
	Trinary Pc(B;A)	49%
	Δ PB1 (%)	-2%
	J_1	51%
	$\Delta J (J_1 - J_0)$	31%

Koonce (1993) proposed that informing another person's responses to a questionnaire would become a consideration factor for the other party and could lead to response variance. Accordingly, in the justification condition, each subject was asked to partner with another subject, and each was asked to write down his or her reasons for choosing particular brands when purchasing one or six bottles. The subjects were then instructed to exchange the reason sheets with their partners. In the no justification condition, the procedure was the same as that in Experiment 1B.

3.2 Results

The results of loglinear analysis listed in Table 2 showed that the relative share of Brand B (the compromise/middle option) without justification increased by 28% ($\chi^2 = 6.42, p < .01$) for the purchase of one bottle and increased by just 8% ($\chi^2 = 3.11, p < .1$) for the purchase of six bottles. The difference in the compromise effect between buying one bottle and six bottles without justification was $J_0 = 20%$ ($\chi^2 = 4.86, p < .05$). The relative share of Brand B (the compromise/middle option) with justification increased by 49% ($\chi^2 = 21.26, p < .001$) for the purchase of one bottle. It decreased by 2% ($\chi^2 = .163, p > .5$) for the purchase of six bottles. The difference in the compromise effect between buying one bottle and six bottles with justification was $J_1 = 51%$ ($\chi^2 =$

19.14, $p < .001$). As a result, ΔJ was significantly larger than zero ($\chi^2 = 3.67, p < .05$).

In short, when the purchase quantity increases, the compromise effect decreases. The impact will be much larger when consumers are required to justify their choices. Justification is certainly a moderator of the relationship between the purchase quantity and the compromise effect, thus rejecting H2b and supporting H2a.

3.3 Discussion

Prior research has suggested that providing justification has a positive effect on the compromise effect (Sheng et al., 2005; Mourali et al., 2007; Drolet et al., 2009). However, although the compromise effect increased in the purchase of one item (21% = 49% - 28%), the compromise effect decreased by 10% (-2% - 8% = -10%) in the purchase of six items (see Table 2). More research was thus needed to understand why the purchase quantity and justification were able to affect the compromise effect in such a way.

In an attempt to investigate whether consumers were motivated by specific psychological factors, each subject was asked to report up to three reasons for their purchase decisions, and the statistical results were displayed in Table 3. Subjects' reasons for their choices for small and large purchase quantities differed. When buying one bottle, 95% of subjects choosing from a binary set justified their decision by attribute preferences, whereas only 35% of subjects choosing from a trinary set justified their decisions by attribute preferences, and 53% justified their decisions using terms such as "middle" or "compromise." These results were in accordance with the predictions for compromise effect theory. Concerning the purchase of 6 bottles, 29% of subjects choosing from a binary choice set justified their decisions by attribute preferences, and 52% justified their decisions using terms such as "balance," "equilibrium," or "avoidance of boredom." For the trinary set, 32% of subjects justified their decisions by attribute preferences, and 57% justified their decisions in terms of balance, etc.

Two things are worth noting. First, 52% of respondents who purchased six bottles in the binary set justified their decisions by using words such as compromise or balance; these terms usually appeared only in the justification of the choice of the middle option in the trinary set. This phenomenon implies that choosing from a binary set can activate consumers' propensity to balance their choices when they plan to buy multiple items. Second, consumers who plan to buy multiple items may spread out their choices among more options to avoid boredom, a concept which has received little discussion in the literature on the compromise effect. In sum, it seems that the negative impact of the purchase quantity on the com-

Table 3: The justifications of buying 1 and buying 6 bottles.

	Buying 1 bottle		Buying 6 bottles	
	Binary	Trinary	Binary	Trinary
Attribute preference	95%	35%	29%	32%
Middle/Compromise/Balance	0%	53%	0%	0%
Balance/Equilibrium/Avoidance of boredom	0%	0%	52%	57%
Habit	0%	3%	10%	6%
Mood	0%	6%	6%	0%
Others	5%	3%	3%	6%
Total	100%	100%	100%	100%

promise effect is rooted in consumers’ desire to achieve balance or equilibrium and to avoid boredom. Therefore, in Experiment 3, two related variables, balance tendency and OSL, are introduced to explain the relationship between the purchase quantity and the compromise effect.

4 Study 3

4.1 Balance heuristic

Balance theory suggests that people pursue balance, order and harmony in their lives (Heider, 1958). This study posits that consumers employ the balance heuristic not only because of the variety-seeking tendency, but also because of the motivation to remain balanced in certain situations. The tendency to use the balance heuristic is a form of variety-seeking behavior, but a variety-seeking behavior does not always achieve balance.

When people plan to buy only one item of product from a trinary choice set, they tend to choose the middle option, as predicted by compromise effect theory. But, if they plan to buy six items, are they inclined to select the middle option? Choosing a compromise option is a way to avoid extremeness or risk; however, buying all six items of one option and no items from the other two options seems to be an extreme strategy, thereby heightening the associated risk. Therefore, adopting a balance heuristic to distribute the six items among more than one option conforms to people’s propensity for risk aversion. In particular, if people buy multiple items with the intention of delegating some of them for future consumption, the consideration of a possible change in preference may bolster their inclination to distribute their purchases among more options. Whenever people desire to achieve balance in making choices, the share of the compromise effect should decrease as a consequence. Therefore, this study proposes two hypotheses:

H3a: When the purchase quantity is larger, the proportion of the compromise option will be smaller, as mediated by a higher balance tendency.

H3b: When the purchase quantity is larger, the proportion of the compromise option will increase or remain the same, as mediated by a higher balance tendency.

4.2 Optimal stimulation level

Optimal Stimulation Level (OSL) can characterize people in terms of their general response to environmental stimuli (Raju, 1980). Some researchers have argued that every organism prefers a certain level of stimulation, called “optimum stimulation” (Hebb, 1955; Leuba, 1955). In brief, when environmental stimulation (derived from conditions such as novelty, ambiguity, and complexity) is below the optimal level, people will attempt to increase stimulation; when it is above the optimal level, they tend to reduce it.

People’s OSLs affect their variety-seeking tendency. In general, the variety-seeking tendency is greater in people with high OSLs than in those with low OSLs (Choi et al., 2006; Menon & Kahn, 1995; Raju, 1980; Steenkamp & Baumgartner, 1992). For individuals who have higher OSLs and thus a higher tendency to display variety-seeking behaviors, choosing multiple items of a product from several comparable options satisfies the desire for variety. One study showed that people who engaged in the simultaneous purchase of multiple items from a product class for sequential consumption exhibited a greater variety-seeking tendency than those who made sequential purchases for sequential consumption (Simonson, 1990). When people with the inclination for variety are making purchases from a trinary choice set, they may choose several options, which results in a relative balance of choices. Accordingly, the OSL could moderate the impact of the purchase quantity on the compromise effect. Two hypotheses are proposed as follows:

Table 4: The proportion of the compromise option, average balance index under each purchase quantity.

Purchase quantity	Compromise option	Balance index
2	58%	35%
3	47%	47%
4	41%	54%
5	37%	55%
6	31%	74%

H4a: The impact of the purchase quantity on the proportion of the compromise option will be stronger among people with high OSLs than among those with low OSLs.

H4b: The impact of the purchase quantity on the proportion of the compromise option will be no different among people with high OSLs and among those with low OSLs.

4.3 Method

306 undergraduate and graduate students participated in the experiment; 168 were female (54.90%) and 138 male (45.10%). The average age was 24.29 years. This experiment was a one factor (a purchase quantity of 2, 3, 4, 5, and 6 items) between-subject design. Five different amounts of the purchase quantity were used to provide more accurate details about changes in the share of the compromise option for different purchase quantities. The purchase of one item was excluded, because it would be impossible to calculate the balance tendency. The measure of the balance tendency is the balance index, which is explained in Appendix 3. A higher balance index implies a greater tendency to adopt the balance heuristic. With regard to the measurement of OSL, the study used 11 of the 39 items in the Arousal Seeking Tendency Instrument provided by Raju (1980), with all 11 items ($\alpha = 0.83$) having been confirmed to have a high correlation to OSL. These items are assessed on a five-point Likert scale, with values ranging from 1 for “completely disagree” to 5 for “completely agree”.

4.4 Results

4.4.1 Hypothesis testing: balance tendency as a mediator

We first examined whether significant differences existed in the number of brands A, B, or C selected for the 5-level purchase quantity. The results indicated that the differences were significant ($\beta = -.902, t = 2.87, p < .001$). The statistics listed in Table 4 showed that, as the purchase quantity increased from 2 to 6 units, the share of

the compromise options decreased from 58% to 31%, and the balance index increased from 35% to 74% ($\beta = .25, t = 4.55, p < .001$).

Three linear regressions were then performed to test the mediating effect of the balance tendency. Specifically, the share of the compromise option was run on the purchase quantity, the share of compromise option was run on balance index, and was run on purchase quantity and balance index simultaneously. The results showed that the purchase quantity had a significantly negative relationship to the share of compromise option ($\beta = -0.27, p < 0.01$) and had a significantly positive relationship with balance index ($\beta = 0.25, p < 0.01$). Furthermore, when the share of the compromise option was regressed for the purchase quantity and the balance index simultaneously, the relationship between the balance index and the compromise option was highly significant ($\beta = -0.32, p < 0.01$). However, the relationship of the main effect to the purchase quantity and the compromise option was also highly significant ($\beta = -0.19, p < 0.01$). The study further compared the β between the main effect and the mediation effect. The absolute value of β decreased significantly from -0.27 to -0.19 . These results were confirmed using the Sobel test ($Z = 3.55, p < 0.05$) (Preacher & Hayes, 2004), which showed that the relationship of the purchase quantity to the proportion of the compromise option was partially mediated by the balance tendency measured by the balance index. Hence, H3b was rejected, and H3a was supported. In sum, people may use the balance tendency as a heuristic when making decisions involving the purchase of multiple items.

4.4.2 Hypothesis testing: OSLs as moderators

A regression analysis was employed to investigate the moderating effect of OSL continuously. The result showed that OSL moderated the relationship between the purchase quantity and the share of the compromise option ($\beta = -.26, t=4.7, p < .001$). Hence, H4b was rejected, and H4a was supported. The study further used the median of the average OSLs to split the subjects into two groups: 1) above the median as having high OSLs and 2) below the median as having low OSLs. Table 5 is a summary of the share of compromise option and the balance index for each level of the purchase quantity for high versus low OSLs. It showed that when the purchase quantity increased, the share of the compromise option decreased with a higher balance index, and the impact of high OSLs ($\beta = -.35, t=4.7, p < .001$) was stronger than that of low OSLs ($\beta = -.14, t=1.6, p > .1$).

Table 5: Compromise option and balance index under each purchase quantity on high OSLs and low OSLs.

PQ	Low OSLs		High OSLs	
	CO	BI	CO	BI
2	50%	33%	67%	38%
3	47%	35%	47%	57%
4	48%	50%	34%	59%
5	33%	59%	40%	51%
6	35%	86%	28%	62%

Note: PQ is the abbreviation of purchase quantity; CO is the abbreviation of compromise option; BI is the abbreviation of balance index.

4.5 Discussion

First, the support of H3a suggests that people's balance tendency may be employed as a heuristic in choosing multiple items of products from multiple choices. Specifically, people may demonstrate a higher balance tendency as the purchase quantity increases, which will result in a lower share of the compromise option. As a result, balance tendency is a mediator for the impact of the purchase quantity on the compromise effect. Second, with regard to the OSL, people with higher OSLs are more likely to demonstrate a greater balance tendency, which in turn will increase the impact of the purchase quantity on the share of the compromise option. For people with lower OSLs, the impact is likely to be weaker.

5 General discussion

The compromise effect has been discussed in terms of the underlying cognitive processes that bring it about (Simonson, 1989), with most of the related research has focused on single-unit rather than multiple-unit choices. Since people generally have a balance tendency and variety-seeking tendency, making a choice involving multiple units may lead them to distribute their choices among more than one available option, thereby giving rise to a lower share of the middle or compromise option. Additionally, prior research has shown that, when people need to justify their decision, their choice of the compromise option may change. Hence, the goal of this paper was to explore the potential impacts that the purchase quantity can have on the compromise effect, incorporating the three constructs of the balance heuristic, the variety-seeking tendency, and the need for justification.

Three experiments were conducted to achieve this

goal. In the first, it was proposed that the purchase quantity may have a negative impact on the compromise effect. The results were as expected for Experiment 1A and Experiment 1B, when purchases were made for immediate and for future consumption. Findings in Experiment 2 confirm the conjecture that the difference in the compromise effect between large and small purchase quantities with justification is greater than that without justification, which led to the conclusion that justification is a moderator in the relationship between the purchase quantity and the compromise effect.

The justifications provided by the subjects revealed that the construct of the balance tendency may be able to explain why the compromise effect decreases as the purchase quantity increases. Experiment 3 was thus conducted to understand the mechanism underlying the impact of the purchase quantity effect on people's choice of the compromise option. The results support the proposition that the decreasing compromise effect can be attributed to people's tendency to maintain a balance state, which heightens their proneness to use a balance heuristic in choosing multiple items of products. In short, people's balance tendency mediates the impact of the purchase quantity on the compromise effect. Experiment 3 also confirmed the moderating role of the OSL, that is, the impact of the purchase quantity on the choice of the compromise option is stronger for people with high OSLs than for those who with low OSLs. This finding, which is in line with the previous studies that people exhibit variety-seeking tendencies when purchasing large quantities (Chernev, 2008; Kahneman & Snell, 1990; March, 1978; Payne et al., 1988; Read & Loewenstein, 1995; Sela et al., 2008; Simonson, 1990).

Some conclusions can be drawn from the findings of this research. First, when individuals are faced with a choice in purchasing a single unit, the middle option may appear more appealing than the other options, because choosing the least extreme option can minimize expected risks and resolve decision conflicts (Chernev, 2008; Choi et al., 2006; Kahneman & Snell, 1990; Read & Loewenstein, 1995; Sheng et al., 2005; Simonson, 1990). However, when individuals are faced with a choice involving the purchase of multiple units, selecting the compromise option for all of them is no longer a good strategy, because it can result in higher rather than lower risks. Therefore, people's balance tendency arises naturally.

Second, the decision to allocate multiple units among a set of options provides people an opportunity to receive more stimulation from novelty and variety, and, accordingly, the share of the compromise option decreases.

Third, the need to justify one's choices enhances the compromise effect in situations involving the choice of a single unit because the individual anticipates evaluations from others (Simonson, 1989; Simonson & Nowlis,

2000). This trend is illustrated in Table 2. But, in cases of multiple-unit choice, the share of the compromise option is diminished by the need for justification, which implies that distributing these purchased units among multiple options is a better strategy as far as the expected risks and anticipation of others' justifications are concerned.

5.1 Theoretical implications

Besides the discussions of contextual effects on variety-seeking (Menon & Kahn, 1995) and the quantity-matching heuristic in multiple-unit purchases (Chernev, 2008), few studies have investigated the effects of contextual factors. Although the findings of this research have implications for a variety of research streams, they apply most to research on the relationship between the purchase quantity and the compromise effect. Most prior research with regard to the compromise effect has generally been limited to cases involving a single choice.

Juxtaposing those findings with the results from this study reveals that the purchase quantity has a negative impact on the share of the compromise option. Moreover, we have presented evidence that the balance heuristic acts as a mediator in the process by which a larger number of purchase items leads to a lower share of the compromise option.

One of this research's theoretical contributions is to point out that the compromise choice may serve to lower expected risks and resolve decision conflicts, but, ironically, it can heighten the associated risks in multiple-unit purchases. Therefore, when the context of decisions allows for the distribution of choices among several options, people tend to balance their choices among the various options.

One interesting finding of this research is that the OSL moderates the impact of the purchase quantity on the compromise choice, showing that people's need to pursue an OSL gives rise to the variety-seeking tendency, which induces them to distribute choices among multiple options. Another finding worthy of note is that—regardless of the positive effect of need of justification on the compromise option, which is attributed to a shift in focus from choices of good alternatives to choice of good reasons (Simonson & Nowlis, 2000)—the impact of the balance tendency operates in the reverse direction by reducing the share of the compromise choice. In other words, the impact of justification on the compromise effect may no longer exist given the adoption of the balance heuristic.

5.2 Marketing implications

Our theoretical framework has a variety of implications for marketing practices. In reality, one-stop shopping is

not only a trend reflecting consumers' need for convenience, but it is also a crucial competitive strategy for marketers. People often buy multiple items from a product category, which is especially true for consumer packaged goods. In this sense, purchase quantity can be a very effective cut-in point decisional variable in the formulation of marketing strategies. Drawing from the findings of this study, the marketer whose brands are the middle options in the marketplace may enjoy an advantageous market share, but this advantage fades away as consumers increase their purchase quantity. On the contrary, brands that are not compromise options should trigger consumers' balance heuristic in order to weaken the compromise effect.

5.3 Limitations and future research directions

One limitation of this study is the homogeneity of the subjects, who were all undergraduate and graduate students, which may give question the study's external validity. Future research should employ respondents with more diverse demographics. Furthermore, the product used in this study was orange juice, which is a packaged consumer packaged good. Considering that the intangible nature of services may bolster consumers' perceived risks, it may be worth asking whether the suggested impact of the purchase quantity on the compromise effect in this study applies to consumer services. Finally, future research that attempts to determine the threshold of the purchase quantity in activating or initiating consumers' balance heuristic or inertia tendency may be interesting and rewarding.

References

- Briley, D., Morris, M., & Simonson, I. (2000). Reasons as carriers of culture: Dynamic versus dispositional models of cultural influence on decision making. *Journal of Consumer Research*, 27, 157–178.
- Chernev, A. (2004). Extremeness aversion and attribute-balance effects in choice. *Journal of Consumer Research*, 31, 249–263.
- Chernev, A. (2005). Context effects without a context: Attribute balance as a reason for choice. *Journal of Consumer Research*, 32, 213–223.
- Chernev, A. (2008). The Role of Purchase Quantity in Assortment Choice: The Quantity-Matching Heuristic. *Journal of Marketing Research*, 45, 171–181.
- Choi, J., Kim, B., Choi, I., & Yi, Y. (2006). Variety-seeking tendency in choice for others: Interpersonal and intrapersonal causes. *Journal of Consumer Research*, 32, 590–595.

- Dhar, R., Menon, A., & Maach, B. (2004). Toward extending the compromise effect to complex buying contexts. *Journal of Marketing Research*, *41*, 258–261.
- Dhar, R., & Simonson, I. (2003). The effect of forced choice on choice. *Journal of Marketing Research*, *40*, 146–160.
- Drolet, A., Luce, M., & Simonson, I. (2009). When Does Choice Reveal Preference? Moderators of Heuristic versus Goal-Based Choice. *Journal of Consumer Research*, *36*, 137–147.
- Hebb, D. (1955). Drives and the C.N.S. (conceptual nervous system). *Psychological Review*, *62*, 243–254.
- Heider, F. (1958). *The psychology of interpersonal relations*. Wiley New York.
- Kahneman, D., & Snell, J. (1990). Predicting utility. In R. M. Hogarth (Ed.), *Insights in decision making: A tribute to Hillel J. Einhorn*, pp. 295–310. Chicago: University of Chicago Press.
- Kivetz, R., Netzer, O., & Srinivasan, V. (2004). Extending compromise effect models to complex buying situations and other context effects. *Journal of Marketing Research*, *41*, 262–268.
- Koonce, L. (1993). A cognitive characterization of audit analytical review. *Auditing: A Journal of Practice and Theory*, *12* (Supplement), 57–76.
- Leuba, C. (1955). Toward some integration of learning theories: The concept of optimal stimulation. *Psychological Reports*, *1*, 27–33.
- March, J. (1978). Bounded rationality, ambiguity, and the engineering of choice. *The Bell Journal of Economics*, *9*, 587–608.
- Menon, S., & Kahn, B. (1995). The impact of context on variety seeking in product choices. *Journal of Consumer Research*, *22*, 285–295.
- Mourali, M., Bockenholt, U., & Laroche, M. (2007). Compromise and attraction effects under prevention and promotion motivations. *Journal of Consumer Research*, *34*, 234–247.
- Preacher, K., & Hayes, A. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavioral Research Methods, Instruments, & Computers*, *36*, 717–731.
- Payne, J., Bettman, J., & Johnson, E. (1988). Adaptive strategy selection in decision making. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *14*, 534–552.
- Raju, P. (1980). Optimum stimulation level: Its relationship to personality, demographics, and exploratory behavior. *Journal of Consumer Research*, *7*, 272.
- Read, D., & Loewenstein, G. (1995). Diversification bias: Explaining the discrepancy in variety seeking between combined and separated choices. *Journal of Experimental Psychology: Applied*, *1*, 34–49.
- Sela, A., Berger, J., & Liu, W. (2008). Variety, Vice, and Virtue: How Assortment Size Influences Option Choice. *Journal of Consumer Research*, *35*, 941–951.
- Sheng, S., Parker, A., & Nakamoto, K. (2005). Understanding the mechanism and determinants of compromise effects. *Psychology and Marketing*, *22*, 591–609.
- Simonson, I. (1989). Choice based on reasons: The case of attraction and compromise effects. *Journal of Consumer Research*, *16*, 158–174.
- Simonson, I. (1990). The effect of purchase quantity and timing on variety-seeking behavior. *Journal of Marketing Research*, *27*, 150–162.
- Simonson, I., & Nowlis, S. (2000). The role of explanations and need for uniqueness in consumer decision making: Unconventional choices based on reasons. *Journal of Consumer Research*, *27*, 49–68.
- Simonson, I., & Tversky, A. (1992). Choice in context: Tradeoff contrast and extremeness aversion. *Journal of Marketing Research*, *29*, 281–295.
- Steenkamp, J., & Baumgartner, H. (1992). The role of optimum stimulation level in exploratory consumer behavior. *Journal of Consumer Research*, *19*, 434–448.

Appendix 1

You go into a convenience store to purchase a bottle of orange juice. You see that the store is offering a special promotion on orange juice: if you buy any six bottles at the same time (not necessarily all the same brand), you will be given a 20% discount on the total price. To take advantage of this special offer, you decide to purchase six bottles of juice.

You see three brands of orange juice on display, all in 500ml bottles, and all costing \$3 each. However, the Vitamin C and fiber content vary across each brand. Your main concern is the Vitamin C and fiber content contained in each of the three brands. The following table provides details of the vitamin C content, fiber content, capacity and price of each brand of orange juice:

Orange Juice	Brand A	Brand B	Brand C
Vitamin C per 100 ml (mg)	30 mg	20 mg	10 mg
Fibers (%)	10%	20%	30%
Capacity (ml)	500ml	500ml	500ml
Price (NTD)	\$3	\$3	\$3

According to the table above, you have decided to purchase six bottles simultaneously. Now, how are you going to buy? Fill out your willing purchase quantity of each brand in the blank space below Brand A, B, and C.

Orange Juice	Brand A	Brand B	Brand C
Purchase Quantity			

Note: The total purchase quantity across the three brands should be six.

Appendix 2

A, B, and C refer to the options, as provided in Figure 1.

Experiment 1A

	The goal of buying 2 bottles		The goal of buying 6 bottles	
	Binary	Trinary	Binary	Trinary
Number of subjects	N=39	N=39	N=41	N=33
Number of observation	O=39	O=39	O=41*6=246	O=33.6=198
A	23 (59%)	9 (33%)	124 (50%)	65 (33%)
B	16 (41%)	21 (54%)	122 (50%)	61 (31%)
C		9(33%)		

Experiment 1B

	The goal of buying 2 bottles		The goal of buying 6 bottles	
	Binary	Trinary	Binary	Trinary
Number of subjects	N=34	N=34	N=34	N=34
Number of observation	O=34	O=34	O=34*6=204	O=34*6=204
A	20 (59%)	6 (18%)	104 (51%)	62 (30%)
B	14 (41%)	23 (68%)	100 (49%)	83 (41%)
C		5 (14%)		59 (29%)

Experiment 2

	The goal of buying 2 bottles		The goal of buying 6 bottles	
	Binary	Trinary	Binary	Trinary
Without justification				
Number of subjects	N=45	N=45	N=45	N=45
Number of observations	O=45	O=45	O=45*6=270	O=45*6=270
A	25 (56%)	10 (22%)	149 (55%)	90 (33%)
B	20 (44%)	26 (58%)	121 (45%)	102 (38%)
C		9 (20%)		78 (29%)
With justification				
Number of subjects	N=45	N=45	N=45	N=45
Number of observations	O=45	O=45	O=45*6=270	O=45*6=270
A	30 (67%)	7 (16%)	132 (49%)	93 (34%)
B	15 (33%)	32 (71%)	138 (51%)	90 (33%)
C		6 (13%)		87 (32%)

Experiment 3

	2 Bottles	3 Bottles	4 Bottles	5 Bottles	6 Bottles
Low OSLs					
Number of subjects	N=38	N=24	N=28	N=30	N=24
Number of observations	N=38*2=76	N=24*3=72	N=28*4=112	N=30*5=150	N=24*6=144
A	17 (22%)	16 (22%)	18 (16%)	48 (32%)	45 (31%)
B	38 (50%)	34 (47%)	54 (48%)	50 (33%)	50 (35%)
C	21 (28%)	22 (31%)	40 (36%)	52 (35%)	49 (34%)
High OSLs					
Number of subjects	N=48	N=28	N=28	N=32	N=26
Number of observations	N=48*2=96	N=28*3=84	N=28*4=112	N=32*5=160	N=26*6=156
A	19 (20%)	23 (27%)	40 (36%)	51 (32%)	53 (34%)
B	64 (67%)	40 (47%)	37 (33%)	64 (40%)	44 (28%)
C	13 (13%)	21 (26%)	35 (31%)	45 (28%)	59 (38%)

Appendix 3

We here formulate a balance index to calculate the degree of each consumer's balance tendency.

Purchase Quantity (PQ) = the quantities someone plans to purchase.

Available Option (AO) = the total number of available options.

Average Quantity (\overline{PQ}) = $\frac{PQ}{AO}$, which stands for the average quantity of every single option.

Option i (\mathcal{O}_i) = the quantities of items being selected in each option i.

For example, if a consumer is going to buy 6 items from a choice set {A, B, C}, then

$$PQ = 6$$

$$AO = 3$$

$$\overline{PQ} = 6/3 = 2.$$

That is, it has reached the balance condition as $\mathcal{O}_A = 2$; $\mathcal{O}_B = 2$; $\mathcal{O}_C = 2$.

As above, when the condition is $\mathcal{O}_A = \mathcal{O}_B = \mathcal{O}_C = \dots = \mathcal{O}_i = \overline{PQ}$, we can say that is balanced; however, when the goal of purchase quantity or available option is 1, then the calculation of balance is not meaningful at all. As a result, we can further derive a formulation of balance deviation to reveal how much balance a consumer has as:

$$Balance\ Deviation = \sum_{i=1}^n \frac{|\overline{PQ} - \mathcal{O}_i|}{|\overline{PQ} - PQ| + (AO - 1)\overline{PQ}} = \sum_{i=1}^n \frac{|\overline{PQ} - \mathcal{O}_i|}{PQ + (AO - 2)\overline{PQ}}$$

$$AO \geq 2$$

$$PQ \geq 2.$$

We made the maximum condition of balance deviation (when there is no balance as the total amount of any available option is purchased) to be the denominator in the formulation. This was done to make it become an index to reveal the extent of the balance deviation. Furthermore, as the formula indicates, when the balance deviation is larger, the degree of balance is lower. Therefore, we used 1 to minus the number of balance deviation to reverse the result as:

$$Balance\ Index\ (BI) = 1 - \sum_{i=1}^n \frac{|\overline{PQ} - \mathcal{O}_i|}{PQ + (AO - 2)\overline{PQ}}$$

Next, we found that the balance index (BI) could be used to calculate the condition of quantity-matching, such as buying 3 items from a set with 3 available options, buying 10 items from a set with 5 available options and so on. When the condition is not quantity-matching, \overline{PQ} will be a non-integer. To make this formulation suitable for use in a non-quantity-matching condition, such as buying 4 items from a set with 3 available options, 5 items from a set with 3 available options and so on, we have adjusted the formulation of BI by rounding \overline{PQ} into an integer and then deducting the adjusted value out. The adjusted formulation of the balance index is as follows:

$$Balance\ Index\ (BI) = 1 - \sum_{i=1}^n \frac{|\lceil \overline{PQ} \rceil - \mathcal{O}_i|}{PQ + (AO - 2)\lceil \overline{PQ} \rceil} - \frac{\mathcal{Y} \cdot (AO \cdot \lceil \overline{PQ} \rceil - PQ)}{PQ + (AO - 2)\lceil \overline{PQ} \rceil}$$

$$AO \geq 2$$

$$PQ \geq 2$$

if $\forall \mathcal{O}_i = PQ$, then $\mathcal{Y} = 0$

if $\forall \mathcal{O}_i \neq PQ$, then $\mathcal{Y} = 1$

if $(\overline{PQ} - \lfloor \overline{PQ} \rfloor) \geq 0.45$, then $\lceil \overline{PQ} \rceil = \text{ceil}(\overline{PQ})$

if $(\overline{PQ} - \lfloor \overline{PQ} \rfloor) < 0.45$, then $\lceil \overline{PQ} \rceil = \text{floor}(\overline{PQ})$

$$\lceil \overline{PQ} \rceil = \text{ceil}(\overline{PQ}) = \min \{n \in \mathbb{Z} \mid n \geq \overline{PQ}\}$$

$$\lfloor \overline{PQ} \rfloor = \text{floor}(\overline{PQ}) = \max \{n \in \mathbb{Z} \mid n \leq \overline{PQ}\}$$