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Managing Intrinsic Load with the Use and Nonuse of the Modality, Pretraining, and Segmenting Multimedia Principles: The Effects on Recall and Transfer

by

Evette R. Daley

A dissertation

submitted in partial fulfillment

of the requirements for the degree of

Doctor of Education in the Department of School Psychology

and Educational Leadership

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Committee Approval

To the Graduate Faculty:

The member of the committee appointed to examine the dissertation of EVETTE R. DALEY find it satisfactory and recommend that it be accepted.

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IRB Approval

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July 18, 2022

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RE: Study Number IRB-FY2022-251: Managing Intrinsic Load with the Use and Nonuse of the Modality, Pretraining, and Segmenting Multimedia Principles: The Effects on Recall and Transfer

Dear Ms. Daley:

Thank you for your responses to a previous review of the study listed above. I agree that this study qualifies as exempt from review under the following guideline: Category 1. Research, conducted in established or commonly accepted educational settings, that specifically involves normal educational practices that are not likely to adversely impact students' opportunity to learn required educational content or the assessment of educators who provide instruction. This includes most research on regular and special education instructional strategies, and research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.
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Please note that any changes to the study as approved must be promptly reported and approved. Some changes may be approved by expedited review; others require full board review. Contact Tom Bailey (208-282-2179; fax 208-282-4723; email: humsubj@isu.edu) if you have any questions or require further information.

Sincerely,

Ralph Baergen, PhD, MPH, CIP
Human Subjects Chair

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Dedication

To my husband, thank you for your love, support, and encouragement.

Also, to myself, thank you for dreaming big and believing in me.

Acknowledgements

I would like to express my gratitude for everyone who has helped me, supported me, and encouraged me through years of schooling. There have been many people who have provided encouragement, advice, and guidance and for that, I am grateful. Thank you to everyone who has had a profound impact on my development and growth throughout my educational endeavors.

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Managing Intrinsic Load with the Use and Nonuse of the Modality, Pretraining, and Segmenting Multimedia Principles: The Effects on Recall and Transfer

Dissertation Abstract--Idaho State University (2023)

This study describes strategies instructional designers can use to foster essential processing when designing multimedia instruction with different combinations of the use and non-use of the pretraining, segmenting, and modality principles described by Clark and Mayer (2016). This study investigated the effects of different combinations of the use and nonuse of the pretraining and segmenting principles, in concert with modality, on recall and transfer test scores within the discipline of consumer decision making. The results from this study provide insight into how the use of one or more Cognitive Theory of Multimedia Learning (CTML) principles impacted overall, recall, and transfer learning outcomes.

Results indicated a combination of two principles (pretraining and modality and segmenting and modality) scored better than the one principle group (modality), the three principle group (pretraining, segmenting, and modality), and the combination of the one and three principle groups for overall and transfer scores. Results also indicated a combination of segmenting and modality was better than modality alone for transfer scores. There was no significant difference among posttest scores for recall when one, two, or three principles were used.

Future research studies could conduct replication or similar studies to further study the complex relationship among these three principles. A replication study to test if the power of the effects can be increased with a larger sample size is needed. Additionally, future research could consider excluding modality, consider a more complex topic or a different instructional design model, restructure the use of pretraining, or consider affective effects and motivation.

If instructional designers want learners to only recall information, modality may be enough. It is recommended that using a combination of either pretraining and modality or segmenting and modality may be sufficient to improve overall, and transfer learning compared to using one or three principles. It may be harmful for learning when instructional designers include the combination of the three principles (pretraining, segmenting, and modality) in their instruction.

Key words: cognitive load theory, cognitive theory of multimedia learning, essential processing, e-learning, intrinsic load, modality principle, multimedia principles, pretraining principle, segmenting principle

CHAPTER I

Introduction

Tragic outcomes can result from extreme cognitive load when performing complex tasks, such as flying an aircraft or operating a nuclear power plant (Paas & van Merriënboer, 1993). Cognitive load is created when there is a need to process incoming information that exceeds a learner's available cognitive capacity (Mayer & Moreno, 2003). Reducing and managing a learner's cognitive load with instructional design techniques has been the focus of many research studies (Ayres, 2006; Cheon et al., 2013; Clark & Mayer, 2016; Colace et al., 2014; Doney, 2019; Eitel et al., 2014; Kester et al., 2006; Lawson & Mayer, 2021; Lusk, 2008; Lusk et al., 2009; Mariano, 2014; Mayer, 2003; Mayer & Chandler, 2001; Mayer & Moreno, 2003; Mayer & Pilegard, 2014; Mayer et al., 2002; Mayer et al., 2017; Mayer et al., 2018; Moreno, 2007; Paas & van Merriënboer, 1993; Reigeluth, 1983; Rey et al., 2019; Schroth, 2000; Wang et al., 2011).

Research on instructional design roots back to Dewey's (1900) call for the development of a science that connected learning theory and educational practice. Instructional design is, "a body of knowledge that prescribes instructional actions to optimize desired instructional outcomes, such as achievement and affect" (Reigeluth, 1983, p. 3). Instructional scientists seek to discover and understand principles of instruction to predict optimal outcomes (Reigeluth, 1983). They focus on when different methods of instruction should be used. Instructional designers (IDs) focus on understanding, improving, and applying these methods of instruction. The internet provided a new way to facilitate learning as the Information Age evolved and as advancements made technology more accessible (Khan, 2000).

As distance education and eLearning became popular, technology created a new paradigm in education (Colace et al., 2014; Doney, 2019; Khan, 2000; Wang et al., 2011).

Advancements made technology more affordable, which resulted in an increased use of technology for learning (Khan, 2000). Between 2012 and 2017, online college enrollment in bachelor's and master's degrees increased 42.59 percent (McGraw, 2020). As the use of technology for learning becomes more widespread, a detailed understanding of how learning happens within technological environments is needed (Clark & Mayer, 2016, Mayer, 2021). Technological advancements have enabled the design of multimedia instruction that combine both audio and visual learning elements (Clark & Mayer, 2016). Clark and Mayer state that with new technologies, such as multimedia technology environments and web-based instruction, instructional design principles and theories for multimedia learning must be implemented. Researchers (Clark & Mayer, 2016; Mayer, 2021) have cautioned instructional designers that using ground-breaking technology without considering how humans learn will result in ineffective instruction.

Traditional instructional strategies and activities increase cognitive load (Brünken et al., 2003). Preventing and reducing cognitive load is an important consideration in designing and developing learning solutions and training complex tasks (Paas & van Merriënboer, 1993). Multimedia principles of instruction need to consider how learners process information during learning (Mayer, 2021). Many theories, such as the working memory model (Baddeley, 1983, 1986, 1992), dual coding theory (Paivio, 1986), cognitive load theory (Sweller, 1988), and the cognitive theory of multimedia learning (Mariano, 2014; Mayer, 2003), have been the result of studying how humans learn.

The human cognitive architecture has been a key contributor to learning theory. The architecture is described as the way cognitive structures are organized and interrelated (Sweller, 2003). According to Sweller's theory, sensory memory is the first entry point for information coming into the brain. Sensory memory was described by Tripathy and Öğmen (2018) as a short information storage in humans where information is registered until it is recognized and potentially transferred to short-term memory. An external stimulus enters sensory memory through the eyes or ears. Sensory memory either attends to the information and begins to process and move the information to short-term memory or forgets it (Sweller et al., 2019); therefore, information in short-term memory is either forgotten, repeated, or processed. If the information is held in short-term memory long enough, it is transferred to long term memory through a process called encoding and is stored in long-term memory (Sweller, 2003). If an external stimulus triggers this information in long-term memory, it is retrieved to short-term memory and connected with the newly input information (Sweller, 2003). In order for information to have the potential to transfer to long-term memory, short-term memory must be managed with a load no greater than seven plus or minus two elements, or chunks, of information at once (Miller, 1956). Miller's findings showed short-term memory is a bottleneck for learning due to its limited capacity (van Gog & Paas, 2008). Peterson and Peterson (1959) found that short-term memory is also limited in duration. According to these authors, information can be held in working memory without being rehearsed for approximately 18 seconds.

Based on the findings for working memory limitations, cognitive load theory (CLT) was developed when Sweller (1988) was studying problem solving. CLT suggests a human's limited processing capacity of working memory contributes to the cognitive load imposed on a learner. CLT suggests instructional materials that direct cognitive capacity to activities that are important to learning can result in more meaningful learning (Cooper, 1990). Meaningful learning is "a deep understanding of the material, which includes attending to important aspects of the presented material, mentally organizing it into a coherent cognitive structure, and integrating it with relevant existing knowledge" (Mayer & Moreno, 2003, p. 43). According to these authors, in order for meaningful learning to occur, learners must actively engage with the material and cognitively process the information. A learner's limited cognitive processing capacity and duration can impact meaningful learning (Clark & Mayer, 2016; Mayer, 2021). Dual-processing theories provide a theoretical foundation for information being processed in separate channels, which can help manage cognitive load by offloading the load of one to channel to separate channels.

Dual-processing theories, such as the working memory model (Baddeley, 1983) and dual coding theory (Paivio, 1986), theorize how the human cognitive architecture helps and hinder learning. These theories provide considerations for helping learners process information. Shell et al. (2010) noted that working memory is continually receiving input from a human's senses. Sensory memory selects what information is attended to in working memory. Baddeley (1986) proposed that a central executive manages two systems. According to Baddeley's working memory model, one system processes visual information, such as written text, and the other processes auditory information, such as narration. These subsystems are referred to as the visuospatial sketchpad and phonological loop subsystems (Baddeley, 1986). Different researchers, such as Clark and Paivio (1991), viewed dual channels in a different way.

Dual coding theory (DCT) "explains psychological phenomena by the collective action of nonverbal and verbal mental systems that are specialized for the processing of imagery and linguistic information" (Clark & Paivio, 1991, p. 150). According to Paivio (1986), imagens, such as pictures, smells, and sounds are handled by the nonverbal system, whereas logogens, such as words, text, and stories, are handled in the verbal system. Findings from DCT provide evidence that these two systems are partially interconnected, but independent processing channels during learning (Paivio, 1986). Humans learn better when they utilize both channels to process information (Clark & Paivio, 1991). Providing learners with auditory and visual components utilizes both channels to reduce the imposed load on processing capacities (Mariano, 2014).

Based on the foundation of dual-processing theories (Baddeley, 1983, 1986; Paivio, 1971, 1991) and cognitive load theory (Sweller, 1988), Mayer (2003) described the cognitive theory of multimedia learning (CTML). CTML is “a research-based theory of how people learn from words and pictures” (Mayer, 2021, p. 31). Mayer’s theory has three central assumptions: dual channels, limited capacity, and active processing assumptions. The principles of CTML are built around these three assumptions and attempt to explain how humans learn more effectively in multimedia environments (Mariano, 2014). Research has been conducted on multimedia instructional design principles and how they help manage or reduce a learner’s cognitive load (Clark & Mayer, 2016; Mayer, 2021).

Clark and Mayer (2016) described several evidence-based multimedia principles to help reduce or manage the cognitive load imposed on learners during a multimedia lesson. These learning principles have evolved from research on CTML (Clark & Mayer, 2016; Mariano, 2014; Mayer, 2003). Many researchers (Lusk et al., 2008; Mariano 2014; Mayer & Chandler, 2001; Mayer et al., 2017; Mayer et al., 2018; Rey et al., 2019; Schroth, 2000) have examined Mayer’s (2003) multimedia principles. These principles have been sorted into three groups: principles that reduce extraneous load, principles that manage intrinsic cognitive load, and principles that foster germane load (Mayer, 2014). Extraneous load is described by Mayer (2014) as working memory capacity used to process information that does not support the intended learning objectives. Mayer described intrinsic load as the cognitive load imposed by concepts and facts necessary to understand the material being taught. Last, germane load is described as the processing effort required to promote schema acquisition and retain information in long-term memory (Mayer, 2014). These cognitive load types will be further described in Chapter II.

Three of the several principles described by Clark and Mayer (2016) have been found to manage intrinsic load (foster essential processing): the modality, pretraining, and segmenting principles. Modality, pretraining, and segmenting are three of the multimedia principles defined by Clark and Mayer (2016). These principles reduce the items a learner must hold in working memory. This reduction has shown evidence to improve learning (Clark & Mayer, 2016; Mayer, 2021).

Pretraining, segmenting, and modality seek to manage intrinsic load (Mayer, 2021). The modality principle states, “People learn better from graphics and narration than from graphics and printed text,” the segmenting principle states, “People learn better when a multimedia lesson is presented in user-paced segments rather than a continuous lesson,” and the pretraining principle states, “People learn more deeply from a multimedia message when they receive pre-training in the names and characteristics of key components” (Clark & Mayer, 2016, p. 463, 465, 467-468). Researchers (Ayres, 2006; Cheon et al., 2013; Clark et al., 2005; Eitel et al., 2013; Kester et al., 2006; Lawson & Mayer, 2021; Lusk et al., 2008; Lusk et al., 2009; Mariano, 2014; Mayer & Chandler, 2001; Mayer et al., 2002; Mayer et al., 2003; Mayer et al., 2017; Mayer et al., 2018; Mayer & Pilegard, 2014; Moreno, 2007; Pollock et al., 2002; Rey et al., 2019; Schroth, 2000) have examined these principles individually to see if they help reduce the intrinsic load imposed on learners during a multimedia lesson. The results of these studies are discussed in further detail in Chapter II. This study focused on the use and nonuse of the pretraining and segmenting principles, combined with modality. These principles were examined within the theoretical framework of the cognitive theory of multimedia learning (CTML).

Problem Statement

A major challenge identified by instructional designers and educators when designing multimedia instruction is being sensitive to the learner's cognitive load during learning (DeLeeuw & Mayer, 2008). Researchers and practitioners must continue to study instructional design strategies to effectively manage cognitive load (Clark & Mayer, 2016). These strategies may help decrease learners' cognitive load and increase recall and transfer of information. A simple conclusion is to use multiple principles because they have shown evidence to improve learning on their own (Cheon et al., 2013; Lawson & Mayer, 2021; Lusk et al., 2008; Mariano, 2014; Mayer & Chandler, 2001; Mayer et al., 2002; Mayer et al., 2017; Mayer et al., 2018; Moreno, 2007; Rey et al., 2019; Schroth, 2000); however, outside of research settings, instructional designers in the real world deal with time and money constraints. If there are no additional improvements when applying multiple principles, implementation of a single principle may be sufficient to foster essential processing.

Purpose of the Study

Numerous researchers have studied the effects of the pretraining, segmenting, and modality principles individually (Clark & Mayer, 2016; Gerjets et al., 2007; Ginns, 2005; Lusk et al., 2008; Mariano 2014; Mayer & Chandler, 2001; Mayer et al., 2017; Mayer et al., 2018; Moreno & Mayer, 1999; Oberfoell & Correiat, 2016; Rey et al., 2019; Schroth, 2000; & Tabbers et al., 2004). The purpose of this study was to further examine different combinations of the use and nonuse of the pretraining and segmenting principles, combined with modality, by comparing posttest scores of four treatment groups: pretraining and segmenting with modality (PSM), pretraining with modality (PM), segmenting with modality (SM), or modality alone (M). The modality principle was used as the baseline comparison group since modality is the standard for multimedia learning, as presenting both visual and auditory information is central to the dual-channels assumption of multimedia learning (Clark & Mayer, 2016; Mayer, 2021). Each of these topics will be further discussed in Chapter II.

This study tested if learners recalled or transferred a new concept more effectively by managing intrinsic load using multiple CTML principles: pretraining and segmenting with modality (PSM) versus pretraining with modality (PM), segmenting with modality (SM), or modality alone (M). This study asked three research questions to determine if learners in the PSM group scored higher on a recall and transfer posttest than the PM, SM, or M groups.

Research Questions and Hypotheses

This study was guided by the following research questions and hypotheses.

1. Do any of the four combinations of the use/non-use of the pretraining and segmenting principles, combined with modality, cause an increase in college learners' overall scores for an online test of consumer decision-making knowledge?

   Research hypotheses for question 1:

   H_0: There is no significant difference in overall posttest scores between the PSM, PM, SM, and M groups.

   H_1: There is at least one significant difference in overall posttest scores between the PSM, PM, SM, and M groups.

2. Do any of the four combinations of the use/non-use of the pretraining and segmenting principles, combined with modality, cause an increase in college learners' recall scores for an online test of recall of consumer decision-making knowledge?

Research hypotheses for question 2:

H_0: There is no significant difference in posttest recall scores between the PSM, PM, SM, and M groups.

H_1: There is at least one significant difference in posttest recall scores between the PSM, PM, SM, and M groups.

3. Do any of the four combinations of the use/non-use of the pretraining and segmenting principles, combined with modality, cause an increase in college learners' transfer scores for an online test of transfer of consumer decision-making knowledge?

   Research hypotheses for question 3:

H_0: There is no significant difference in posttest transfer scores between the PSM, PM, SM, and M groups.

H_1: There is at least one significant difference in posttest transfer scores between the PSM, PM, SM, and M groups.

Research Design

An experimental, randomized, posttest only, control group design was used in this study (see Table 1). Participants were randomly assigned to one of the four treatment groups (PSM, PM, SM, and M). After each group received their randomly assigned treatment, an anonymous posttest was administered via Qualtrics. The posttest included participant's consent, captured exclusion criteria, and consisted of ten recall and ten transfer questions.

Table 1

Research Design for the Proposed Study

Group	Random Assignment	Treatment	Posttest	Demographic Survey
PSM Pretraining and segmenting with modality	*R*	X_3	T_1	S_1
PM Pretraining with modality	*R*	X_2	T_1	S_1
SM Segmenting with modality	*R*	X_1	T_1	S_1
M Modality	*R*	X_0	T_1	S_1

Note. *R* indicates random assignment to groups. X_x represents the treatment groups, T_1 represents the cognitive posttest, and S_1 represents the demographic survey.

Delimitations

Delimitations threaten the external validity of a study. Factors that are controlled by the researcher and may have affected the study results are delimitations (Creswell, 2012). According to Bracht and Glass (1968), external validity threats fall into two expansive classes: population validity (What populations can be expected to behave the same way?) and ecological validity "(Under what conditions, i.e., settings, treatments, experimenters, dependent variables, etc., can the same results be expected?)" (p. 438). These authors identified twelve potential threats that may impact the external validity of a study. Some of these threats, such as multiple treatment interface, experimenter effect, and pretest sensitization did not apply to this study because of the research design. Each participant received one treatment, no experimenter was involved in the treatment since the course was administered online via Moodle, there was no pretest, and the content was consistent among all four treatment groups and only varied with how the content was presented. The delimitations applicable to this study are described below.

Population Validity

This section addresses population validity applicable to this study. In this study, population validity threats included experimentally accessible population versus target population and interaction of personological variables and treatment effects.

Experimentally accessible population versus target population. The target population for this study was college learners enrolled in an introductory personal finance course taught in the college of business at a four-year university located in the Intermountain West. The accessible population consisted of all learners enrolled in the introductory course at the participating institution in the Intermountain West. The sampled course is considered part of the general education requirements; therefore, there were a variety of majors, including business and non-business majors exploring major options who were fulfilling general education requirements. If a learner had a high level of prior knowledge about consumer decision making types, or were retaking this course, they were excluded from the study. The results of this study are only applicable to novice learners. Chapter V will further discuss the results for novice learners and consumer decision making knowledge.

Since this study was conducted at one university, the generalizability beyond the accessible population is limited. Participants in this study were enrolled in several sections of the same introductory business course. Participants were randomly assigned to one of the four treatments. Because of the variability in sections and random assignment, study results can be generalized to other learners enrolled in the same introductory finance course at this specific university. This study was limited to learners in an introductory personal finance course;

therefore, the results may not be generalizable to other learners or content areas. In addition, the selected university's demographics/school characteristics may not apply to schools with different demographics or characteristics. Demographics/school characteristics of the sample in this study are further described in Chapter IV.

Interaction of personological variables and treatment effects. Due to the accessible population of this study (learners enrolled in the personal finance course), it was assumed that most learners were novices to consumer decision making types. There was no pretest in this study. To participate in the study, participants were told they could have no prior knowledge of consumer decision making. Participants who had prior knowledge were excluded from the study. The researcher made this decision based on cognitive load research (Sweller et al., 2003). According to these authors, learners with prior knowledge can process information better than novice learners with no existing schemas. Impacts of prior knowledge will be discussed in a later chapter.

Ecological Validity

This section addresses ecological validity. In this study, ecological validity threats include describing the independent variable explicitly, the Hawthorne effect, novelty and disruption effects, posttest sensitization, and interaction of history and treatment effects. Each of these are discussed in the following sections.

Describing the independent variables explicitly. Readers of this paper rely on a detailed description of several variables, including the independent variables and research design (Bracht & Glass, 1968). This study was delimited to the multimedia pretraining and segmenting effects, combined with modality. According to Bracht and Glass (1968), a detailed description of the independent variables (pretraining and segmenting in this study) allows other researchers to replicate the study. These authors state that giving an explicit description of the research design is essential for readers to know if the results are generalizable to other situations. Chapter III provides a detailed description of the independent variables and research design. To briefly describe, the modality principle was included in all four treatment groups as a baseline. Although modality was not considered a variable, it may have impacted the results of the other independent variables. The use of modality included onscreen visual elements with narration rather than the use of onscreen visual elements and text (Mayer, 2021). Evidence from prior research (Clark & Mayer, 2016; Ginns, 2005; Mayer, 2021; Moreno & Mayer, 1999; Oberfoell & Correiat, 2016; Rummer et al., 2011) showed modality is the standard for multimedia learning. Onscreen visual elements and on-screen text are less effective for novice learners compared to onscreen visual elements and narration or audio components (Clark and Mayer, 2016; Mayer, 2021).

Hawthorne effect. According to Bracht and Glass (1968), the Hawthorne Effect occurs when "a subject's behavior may be influenced partly by his perception of the experiment and how he should respond to the experimental stimuli" (p. 439). The instruction included was an optional assignment within the introductory finance course. Learners were informed of the instruction the first day of the week in which they were given the assignment. Learners enrolled in the course were not required to do the assignment but had the option to participate or not participate in the study at any time. If learners viewed this study as a normal assignment rather than an experiment, the Hawthorne Effect may have been reduced.

Novelty and disruption effects. Only one of the five of sections of the FIN1115: Personal Finance course offered was an online course. Since the treatments were presented in a modality (web-based instruction) that was different than the usual course modality (instructor-led instruction), the novelty effect could have been threat (Bracht & Glass, 1968). Learners were required to use Moodle for normal class assignments and because the treatments were administered at the beginning of the semester, learners may not have had a set expectation for how the instruction should have been presented. If learners had issues with how the content was presented, it may have impacted results.

Posttest sensitization. Learners in the segmenting groups were given segmenting breaks with practice recall and transfer questions at the end of each active segment break, whereas learners in the no segmenting groups were given a continuous lesson with questions at the end of the entire lesson. External validity could have been threatened because the posttest could have provided an additional learning opportunity and false positive results of the treatment (Bracht & Glass, 1968). It is unlikely that this delimitation affected the different groups because all participants received the same posttest at the end of the instruction, regardless of if the practice activities were provided during the segmenting breaks or at the end of the continuous lesson. The questions were intended for practice; therefore, scores on the activities were not collected or analyzed. Only posttest scores were collected and analyzed. Confirmatory or remediatory feedback was provided based on learners' responses to the practice questions. Details on the provided feedback will be described in a later chapter.

Interaction of history and treatment effects. Results of the treatments may have been impacted by historical conditions at the time of the experiment. The researcher was not aware of any such conditions that may have affected the results of the study.

Measurement of the dependent variable. The researcher's hypotheses that the pretraining and segmenting principles affected learners' recall and transfer was the premise of the dependent variables. Other dependent variables could have been explored to make this study more generalizable. For this study, learner performance in the terms of recall and transfer was chosen and assessed. The dependent variables, overall posttest scores, recall posttest scores, and transfer posttest scores, were measured by multiple-choice and categorization questions. These question types were chosen to remove grading bias. Other assessment instrument designs may not be consistent and therefore, may limit the generalizability of the study.

Interaction of time of measurement and treatment effects. Learner performance was assessed immediately after the treatment was completed. Because there was no delayed summative assessment, the external validity may have been threatened. The posttest was used to measure short-term learning; therefore, the results of this experiment are not generalizable to delayed transfer since delayed transfer was not assessed in this study. Based on this study, it is unknown if learners could recall and transfer information over the long-term. Recommendations to address this delimitation are described in Chapter V. Some other specific delimitations of this study include:

- Clark and Mayer (2016) noted that very little is known about how big a segment should be and how much information should be included in a segment; therefore, segment lengths weren’t equivalent. They ranged from thirty seconds to one minute and fifteen seconds and were created through natural breaks in the content.
- A designated time, such as a few set hours, was not assigned to this study. Data was captured within a two week time frame.
- Learners in some groups may have been annoyed or had click fatigue as they advanced through the treatment. This is discussed in more detail in Chapter V.
- Schema may not be developed immediately after pretraining whereas the pretraining introduced particular topics before the lesson. This is also further discussed in Chapter V.

Limitations

The researcher could not control some potential weaknesses or problems within the study (Creswell, 2012). These limitations threaten the internal validity of the study. According to Isaac and Michael (1995), "internal validity asks the question: did, in fact, the experimental treatments make a difference in this specific instance" (p. 66)? Campbell and Stanley (1966) described eight classes of extraneous variables which may produce confounding effects with the effect of the experimental treatments if not controlled in an experimental design.

Some of the limitations described by these authors, such as history, maturation, testing, statistical regression, selection, and selection-maturation interaction, were reduced by randomly assigning participants to treatment groups and using a baseline comparison group. Some of the imposed threats were reduced by the research design of this study. Instrumentation and experimental mortality may have imposed limitations on this study. These potential weaknesses are described in the following sections.

Instrumentation

Measurements obtained by the study can be impacted by changes in testing instruments, human raters, or interviewers (Campbell & Stanley, 1966). To reduce this threat, testing instruments were held constant throughout the duration of the study and no changes were made. Each treatment group received the same review and posttest questions. The treatments were administered via SCORM 1.2 packages, and the posttest was administered through an anonymous Qualtrics link, on the Learning Management System (LMS) Moodle. Human raters were not part of the study. Interviews were not used in this study. The research design mitigated most of the instrumentation threat to internal validity.

Validity of the test instrument was tested and assessed. Content validity (Carmines & Zeller, 1979) "depends on the extent to which an empirical measurement reflects a specific domain of content" (p. 20). Content validity was checked by having subject matter experts (SMEs) review the questions to ensure the content measured what it intended to measure, in this study, recall and transfer of types of consumer decision making.

Experimental Mortality

A potential threat to the internal validity of this study was more learners dropped out of one group over another (Campbell & Stanley, 1966). Participants were randomly assigned to one of four treatment groups (PSM, PM, SM, or M). The experiment was conducted during the early weeks of the semester so the threat of learners dropping the course was relatively high. Because some learners chose not to participate in the study (either before or during), or failed to finish the study, a threat to experimental morality may have existed. A decent sample size helped reduce the threat of experimental mortality (Campbell & Stanley, 1966). The minimum sample size for each group in this study was 30. A total sample size of at least 200 was desired; however, 120 participants was sufficient, as long as each group had a minimum of 30 participants, or very close to 30 after the data was cleaned. The actual sample size, as well as future recommendations for a larger sample size, will be discussed in future chapters.

Definition of terms

Cognitive load: "The amount of mental effort involved in working memory" (He, n.d., p. 1).

Cognitive affective theory of learning with media (CATLM): Extends the CTML (defined below) by considering affect and motivation in learning. This theory considers additional factors that mediate learning by increasing or decreasing the amount of cognitive resources a learner invests on the given task (Moreno, 2006).

Cognitive theory of multimedia learning (CTML): Learners attempt to build meaningful connections between words and pictures. They learn more deeply with words and pictures together than they would have with words or pictures alone (Mayer, 2021).

Contrast: "Significance tests of focused questions in which specific predictions can be evaluated by comparing these predictions to the obtained data" (Rosenthal and Rosnow, 1985, p. 1).

Extraneous load: Cognitive processing that does not supporting the learning objectives, such as irrelevant graphics (Sweller, 1994)

Germane load: Is aimed at deeper understanding and is created to motivate the learner to make sense of the material. This load type can be supported by instructional methods that facilitate learner engagement with the material (Sweller, 1994).

Instructional design: The design and development of instructional content (Reigeluth, 1988)

Intrinsic load: The fundamental level of difficulty that corresponds with an instructional topic (Sweller, 1994)

Meaningful learning: "A deep understanding of the material, which includes attending to important aspects of the presented material, mentally organizing it into a coherent cognitive structure, and integrating it with relevant existing knowledge" (Mayer & Moreno, 2003, p. 43)

Modality principle: "People learn better from graphics and narration than from graphics and printed text" (Sorden, n.d., p. 8)

Multimedia instruction: Instruction "containing words (such as narration or on-screen text) and graphics (such as illustrations, photos, animation, or video)" (Clark & Mayer, 2016, p. 464)

Novice learner: "Novices, not possessing appropriate schemas, are not able to recognize and memorize problem configurations and are forced to use general problem-solving strategies such as means-ends analysis when faced with a problem" (Sweller, 1988).

Pretraining principle: "People learn more deeply when lessons present key concepts prior to presenting the processes or procedures related to those concepts. The goal is to minimize essential processing overload" (Clark & Mayer, 2016, p. 465).

Recall: The ability to remember previously learned information (Dobson, Linderholm, & Stroud, 2019)

Redundancy: The inclusion of extra information, such as including both narration and on screen dialogue of the spoken words (Clark & Mayer, 2016)

Segmenting principle: "People learn more deeply when content is broken into small chunks and learners can control the rate at which they access the chunks. A good strategy for managing complex content that imposes considerable essential processing" (Clark & Mayer, 2016, p. 468).

Transfer: "Application of previously learned knowledge and skills to new situations encountered after the learning event. Relies on retrieval of new knowledge and skills from long-term memory during performance" (Clark & Mayer, 2016, p. 471).

Working memory: "An alliance of separate but interacting temporary storage systems, possibly coordinated by a single executive" (Baddeley, 1983, p. 311).

Significance of the Study

The results of this study offer additional insights into the design and development of instructional materials within academic and real-world settings. The findings from this study can help instructional designers consider ways to make multimedia instruction more effective. The insights may be particularly relevant for how the use of one or more CTML principles impact learning outcomes by managing intrinsic load. This research study investigated the effects of different combinations of the use and nonuse of the pretraining and segmenting principles, in concert with modality, on recall and transfer test scores within the discipline of consumer decision making. The results from this study may inform designers if the use of one CTML principle provides the same learning benefit as the use of multiple CTML principles. This study contributes to the improvement of instructional design implementation and practices and identifies research needs and suggests future studies. Recommendations for future practice and research are discussed in further detail in Chapter V.

CHAPTER II

Review of the Literature

The purpose of this experimental study was to test if learners recalled and transferred a new concept more effectively by managing intrinsic load using multiple CTML principles (segmenting, pretraining, and modality), two pairs of principles (pretraining and modality or segmenting and modality), or a single principle (modality). The literature review for this study investigated the following research areas: instructional design; technology and e-learning; cognitive architecture; working memory; dual coding theory (DCT); cognitive load theory (CLT); the cognitive theory of multimedia learning (CTML); the modality, segmenting, and pretraining principles; recall; and transfer.

Instructional Design

Over the past four decades, terms such as "systems approach, instructional development, learning system design, competency-based instruction, instructional design, instructional systems design (ISD), have been used to define a systematic approach to instructional design" (Tozman, 2004, p. 3). The historical roots of the instructional design field were largely influenced by World War II when psychologists, educators, and professionals in training, and with experience in conducting experiential research, developed instructional materials for the U.S. military (Reiser, 2001). Some of the well-known contributors during this time include Gagne, Briggs, and Flanagan (Dick, 1987).

Post-World War II, the American Institute for Research, and other organizations, were created to solve instructional problems (Castro-Figueroa, 2009). Organizations retained many of the psychologists who viewed training as a system and enabled them to continue innovating the analysis, design, and evaluation of instructional solutions (Dick, 1987). Practical developments for instructional design concepts happened in the 1960s. The systematic design of instructional materials, through the use of models or processes, was the result of these linked concepts (Reiser, 2001).

In the 1970s, scholars began creating instructional design models to support a systematic approach to instruction (Dick & Carey, 1978; Gagne & Briggs, 1974; Gerlach & Ely, 1971; Kemp, 1971). According to Reigeluth (1983), “The discipline of instructional design (which is often called instructional science) is concerned with producing knowledge about optimal ‘blueprints’– knowledge about what methods of instruction will optimize different kinds of desired outcomes” (p. 12). Most of the early research in the field was focused on the instructional design process and models and little attention was given to instructional design theory (Reigeluth, 1983).

According to Reigeluth (1999), “an instructional design theory is a theory that offers explicit guidance on how to better help people learn and develop” (p. 5). Instructional design theory can provide instructional designers with practical guidelines and frameworks to use through their design process (Reigeluth, 1983; Reigeluth, 1999). There are multiple learning theories that created the foundation for instructional design processes, theories, and models (Reigeluth, 1999). Instructional designers use these theories, as well as practical implications from research to guide their processes and practices. Reiser (2001) provided a detailed description of instructional design:

> The field of instructional design and technology encompasses the analysis of learning and performance problems, and the design, development, implementation, evaluation, and management of instruction and non-instructional processes and resources intended to improve learning and performance in a variety of settings, particularly educational institutions and the workplace. (p. 53)

According to Reigeluth (1999), instructional design methods do not guarantee the achievement of a goal, but rather increase the chances of reaching the goal. There is a growing demand for instructional design techniques that incorporate evidence-based teaching and learning strategies to engage learners using technology and media (Richardson et al., 2019).

Instructional design practices were adopted by higher education institutions and later by business and industry sectors (Miles, 1983). As technological advancements have been made, technology has become more affordable and have been incorporated into learning (Khan, 2002), which has created additional design decisions for instructional designers (Clark & Mayer, 2016). Distance education and e-learning became popular during the Information Age as more educators and practitioners began using technology to create and deliver instructional content and facilitate learning (Clark & Mayer, 2016).

Technology and e-Learning

Information technology advancements created a new paradigm in education (Khan, 2002). For decades, educators across the glove have been chasing initiatives to promote and support technology and computers for learning (Collis, 1996). According to Collis, “In the 1960s, research initiatives began relating to the use of computers for educational purposes, and the study of the computer science was established as academic and professional domains” (p. 22). The personal computer (PC) made it easier for individuals to have access to and use technology (Collis, 1996). Collis noted the PC enabled “broadscale educational activity” on a computer for the first time (p. 24).

The development of the World Wide Web (WWW) and internet stimulated more interest in using technological advancements in education (Collis, 1996). E-learning was defined as “instruction delivered on a digital device that is intended to support learning” (Clark & Mayer, 2016, p. 7). With advancements in technology, the web has become a medium for learning and instruction that creates collaborative, meaningful, and relevant learning opportunities (Khan, 2002). Khan mentioned the internet created the opportunity for web-based instruction (e-learning) to provide an “innovative approach for delivering instruction to a remote audience” (p. 63). As e-learning technology has become more affordable, especially in higher education, utilizing technology for content delivery has become a trend in the industry (Muniasamy & Alasiry, 2020). Data (Chernev, 2022; National Center of Education Statistics [NCES], 2020) that shows these e-learning trends are discussed below.

According to Chernev (2022), in 2017 approximately 77 percent of U.S. corporations offered e-learning and 98 percent planned to offer e-learning by 2020. Between 2020 and 2024, the e-learning market in the U.S. is expected to grow by $12.81 billion (Chernev, 2022). According to Chernev, the worth of the worldwide e-learning market is projected to reach $325 billion by 2025. According to NCES (2020), “in fall 2019, there were 7,313,623 students enrolled in any distance education courses at degree-granting postsecondary institutions.” These statistics are shown below in Table 2.

Table 2

Distance Education Statistics for Fall 2019 for Institutions in the 50 United States and the District of Columbia

Number and percentage of students enrolled in degree-granting postsecondary institutions, by distance education participation, and level of enrollment and control of institution: Fall 2019

Level of enrollment and control of institution	Number of students					Percent of students				
			Any distance education course(s)					Any distance education course(s)		
	Total	No distance education courses	Total, any distance education course(s)	At least one, but not all, of student's courses are distance education courses	Exclusively distance education courses	Total	No distance education courses	Total, any distance education course(s)	At least one, but not all, of student's courses are distance education courses	Exclusively distance education courses
Total	**19,637,499**	**12,323,876**	**7,313,623**	**3,863,498**	**3,450,125**	**100.0**	**62.8**	**37.2**	**19.7**	**17.6**
Level of enrollment										
Undergraduate	16,565,066	10,552,130	6,012,936	3,563,377	2,449,559	100.0	63.7	36.3	21.5	14.8
Postbaccalaureate	3,072,433	1,771,746	1,300,687	300,121	1,000,566	100.0	57.7	42.3	9.8	32.6
Control of institution										
Public	14,501,057	9,254,592	5,246,465	3,314,230	1,932,235	100.0	63.8	36.2	22.9	13.3
Private nonprofit	4,145,263	2,804,726	1,340,537	444,872	895,665	100.0	67.7	32.3	10.7	21.6
Private for-profit	991,179	264,558	726,621	104,396	622,225	100.0	26.7	73.3	10.5	62.8

Source: "U.S. Department of Education, National Center for Education Statistics" (forthcoming) *Digest of Education Statistics 2020,* Table 311.15.

Using the web as a delivery method for instruction requires careful analysis and investigation on how to best align instructional design principles with the design and implementation of the instruction (Khan, 2002). Clark and Mayer (2016) noted in order for technology to provide additional learning benefits, technology must be used in a way that considers and supports human cognitive learning processes. The use of technology does not guarantee learning (Clark & Mayer, 2016). Wang et al. (2011) further provided evidence that using technology does not guarantee learning. These authors found although some organizations were using e-learning to enhance workplace skills; however, many of these e-learning initiatives did not support learning. The lack of consideration for the human cognitive architecture was a significant contributor to a lack of motivation. This lack of motivation resulted in a gap between learning and real work performance (Wang et al., 2011).

Another study by Pontefract (2019) pointed out that what happens after training (transfer) is a problem for organizations. This author used a "spray and pray" analogy to describe organizational training approaches. Pontefract (2019) describes how organizations spray out information, like the learner is trying to drink from a firehose. The organization prays the information presented is retained and applied upon completion of the training. This strategy is not effective for an organization's bottom line or for a learner's knowledge acquisition and performance. With the cost of e-learning, it is important for organizations to consider the return on their training investment (Muniasamy & Alasiry, 2020; Pontefract, 2019, Wang et al., 2011). To maximize returns, learning theories and models must be considered (Clark, 2005; Clark & Mayer, 2016; Freifeld, 2021; Khan, 2002; Muniasamy & Alasiry, 2020; Pontefract, 2019; Wang et al., 2011).

Cost. A major drawback to using technology for learning is developing technological resources is still expensive (Muniasamy & Alasiry, 2020). Training Magazine's 2021 Training Industry Report showed companies spent an average of $1,071 per employee on training in 2021, compared to a cost of $1,111 per employee in 2020 (Freifeld, 2021). This report suggests the COVID-19 pandemic influenced the average amount spent on training employees, as companies spent an average of $1,286 per employee in 2019. Although the cost of training is impossible to avoid, organizations can better manage their training budget by understanding what influences the cost of training and maximize their return on investment by utilizing strategies that effectively and efficiently promote learning (Freifeld, 2021). It is particularly important for organizations to maximize their returns on e-learning, as it is becoming more widely used and is costly to design and develop.

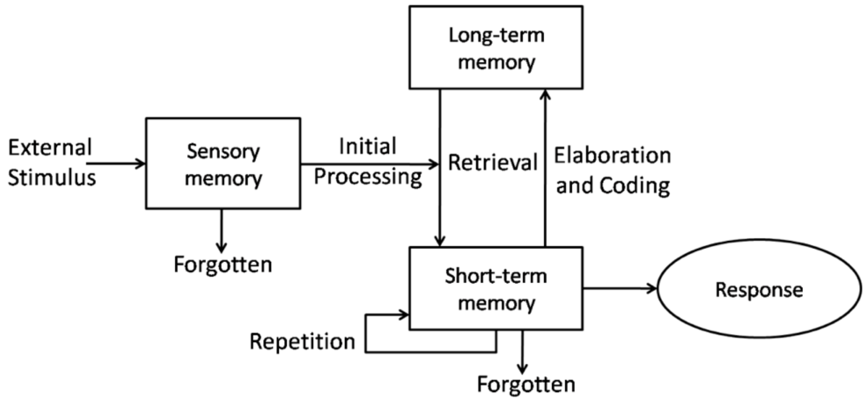
E-learning selection, design, and development should be grounded in evidence-based practices (Clark, 2005). More information on effective instruction and pedagogy to enhance e-learning is still needed (Clark & Mayer, 2016; Muniasamy & Alasiry, 2020). The human cognitive architecture provides a foundation for e-learning instructional design as it describes how learners receive, process, learn, and retain information (Alasraj, 2011; Clark, 2005; Clark & Mayer, 2016; Mayer, 2021; Sweller, 1988; Sweller, 1994; Sweller, 2003). The human cognitive architecture is further discussed in the next section.

Cognitive Architecture

The human cognitive architecture refers to the way cognitive structures are organized in the brain (Sweller, 2003). When an external stimulus, such as instructional content, enters the brain, sensory memory either begins to process this information in working memory or forgets it (Sweller, et al., 2019). According to Sweller's theory, sensory memory is the entry point for information. Sensory memory is described by Tripathy and Öğmen (2018) as a storage system in the human brain where information is briefly held until it is recognized and potentially transferred to working memory or forgotten. According to Sweller (2003), information transferred from sensory memory to working memory is either forgotten, repeated, or processed. If the information is held in working memory long enough through either processing or repetition, it is encoded and stored in long-term memory (Sweller, 2003). If an external stimulus triggers this information in long-term memory, it is retrieved to working memory and connected with the new information in working memory (Sweller, 2003). The human memory processing model is shown in Figure 1 below (Alasraj et al., 2011).

Figure 1

Human Memory Processing Model



Note. From "Considering cognitive load theory within e-learning environments" by A. Alasraj, M. Freeman, and P. Chandler, 2011, p. 3. *PACIS 2011 Proceedings,* 14. The author's written permission to include a copy of this figure is shown in Appendix A: Permissions.

Miller (1956) found that working memory has a limited capacity. Miller found in order for information to have the potential to transfer to long-term memory, working memory must be managed with a maximum load of seven plus or minus two chunks of information. Peterson and Peterson (1959) found working memory is also limited in duration. These authors found working memory has a duration of approximately 18 seconds. Baddeley (1986) built on this idea and suggested it is the time information must remain in working memory without rehearsing that determines working memory capacity. With the limited capacity and duration of working memory, it is "the bottleneck for learning" (van Gog & Paas, 2008, p. 4).

Long term memory is fundamentally different than short term memory because long term memory is believed to have an unlimited capacity and duration (Sweller, 2003). According to this author, long term memory is the storage of information for an unlimited time. Long term memory is where memories and information are held until the information is retrieved to short term memory. This information can be held for days or years before it is retrieved (Sweller, 2003).

van Merriënboer and Sweller (2005) further expanded on Miller's (1956) assumption working memory could store five to nine chunks of information. The authors stated that working memory can only process two to four chunks of information at once. Sweller (1988) noted that schema acquisition, elaboration, and automation can reduce the amount of load imposed on working memory capacity. Schema acquisition, elaboration, and automation are described in further detail later in this chapter.

These processes are central to learning because previously learned information and held in long term memory is not constrained by the limited capacity or duration of working memory. These limitations are managed when previously learned information is retrieved from long term memory and brought to working memory because the items retrieved can be processed as one chunk of information in working memory (Ericsson & Kintsch, 1995).

The Working Memory Model

Early research viewed memory as a singular unit; however, in the late 1960s research began to support a multidimensional view of memory (Baddeley, 2006). Baddeley (1983) described working memory as "an alliance of separate but interacting temporary storage systems, possibly coordinated by a single executive component" (p. 311), where working memory and long-term memory were viewed as separate systems (Baddeley, 2006). Baddeley (1992) began exploring the idea of a singular short-term storage that acted as a working memory. The results of these findings contributed to the development of the working memory model (Baddeley, 2006).

The original working memory model included a pyramidal central executive and two supplemental slave systems, referred to as the phonological loop and visuospatial sketchpad (Baddeley, 1983; 1986). A key component of the working memory model is the central executive (Baddeley, 1983). According to Baddeley, the central executive coordinates information from the phonological loop and visuospatial sketchpad to manage working memory resources. These components are described in later paragraphs. Baddeley's (1983) early working memory model is shown below in Figure 2.

Figure 2

The Three Component Model of Working Memory

Note. Baddeley and Hitch (1974) proposed a three component model of working memory. These three components were the attentional control system, central executive, and subsidiary storage systems for phonological and visuospatial information. From "Working memory and language: An overview" by A. Baddeley, 2002, p. 191. *Journal of Communication Disorders, 36.* The permission to provide a copy of this figure is shown in Appendix A: Permissions.

The phonological loop deals with verbal information (Baddeley, 1986; Baddeley, 1992; Baddeley, 2006). According to Baddeley, the phonological loop has two main components: a phonological store and an articulatory control process. These two components help the phonological loop function. Speech-based information is held for one to two seconds in the phonological store (Baddeley, 1986). The articulatory control process functions like an inner dialogue that rehearses information from the phonological store (Baddeley, 1986). According to

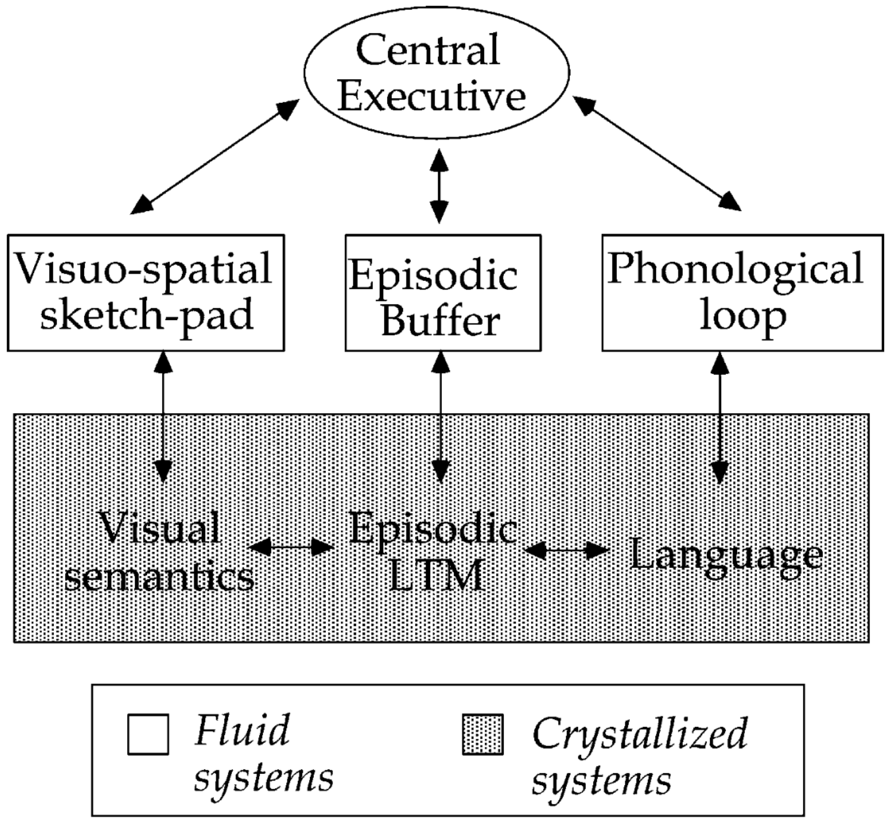
Baddeley, this information is repeated and remembered; therefore, the phonological store is supported by subvocal repetition (Baddeley, 1986). According to Baddeley, subvocalization allows the phonological loop to enter visually presented material in the phonological store.

The visuospatial sketchpad deals with visual and spatial information, as well as verbal information (Baddeley, 1983; 1986). According to Baddeley (2000), this system stores visual and spatial information and is separated into visual, spatial, and possibly physical components. Working memory includes both an auditory and visual working memory, which are comparable to the phonological loop and visuospatial sketchpad (Baddeley, 1986; 1992).

Later, a third system was added to the working memory model (Baddeley, 2000). This system, referred to as the episodic buffer, linked working memory and long-term memory. Baddeley (2006) described the episodic buffer as an interface between different types of information in working and long-term memory. With this addition, the new model is shown below in Figure 3.

Figure 3

The Current Multi-Component Model of Working Memory



Note. The episodic buffer is believed to function as a temporary storage system that allows information from the subsystems and long-term memory to be combined. From "Working memory and language: An overview" by A. Baddeley, 2002, p. 203. *Journal of Communication Disorders, 36.* The permission to provide a copy of this figure is shown in Appendix A: Permissions.

The working memory model assumes that visual and verbal information is handled by different systems: the visuospatial sketchpad and phonological loop (Baddeley, 1983, 1986, 1992, 2000, 2006). The working memory model was expanded by Sweller and Paivio (Clark & Paivio, 1991; Paivio, 1971, 1986, 1991; Sweller, 1988, 1994, 2003; van Merriënboer & Sweller, 2005). According to Sweller (2003), there is no central executive that handles new information; therefore, working memory is limited.

According to Sweller (2003), when handling prior knowledge held in working memory, the prior knowledge acts as a central executive. This allows new information to be processed and integrated with existing knowledge in working memory (Sweller, 2003). Sweller's (1988) cognitive load theory (CLT) will be discussed later in this chapter. Paivio's (Clark & Paivio, 1991, 1971, 1991) dual coding theory (DCT) elaborated on the idea of two separate channels that process visual and verbal information and how they are connected to long-term memory. DCT is described in the next section.

Dual Coding Theory

DCT assumes there are two separate systems that handle the representation and processing of verbal information and non-verbal information (Paivio, 1971; Paivio, 1991). Paivio (1991) referred to verbal representations as logogens and nonverbal representations as imagens. Reed (2006) noted that DCT "provided an important foundation for subsequent cognitive architecture because of its distinction between verbal and visual coding of information" (p. 87). According to DCT, pictures, smells, and sounds are handled by the nonverbal system and words, text, and stories are handled by the verbal system (Clark & Paivio, 1991). The two systems are separate from one another; however, they are interconnected and can work interdependently (Paivio, 1991). Having two memory codes (pictures and words) provides a better chance of remembering something versus one code (words or picture alone) (Reed, 2006).

According to Paivio's DCT (1991), there are three levels of processing that allow verbal and visual representations to be attained and activated. These three levels of processing in the dual channels include representational, referential, and associative processing. Representational processing includes direct activation of verbal code and nonverbal code (Doolittle et al., 2005). According to these authors, referential processing includes indirect activation where the verbal system is activated by nonverbal information and the nonverbal system is activated by verbal information. Associative processing includes activation of representations within either system by other representations in the same system (Doolittle et al., 2005). These three levels of processing support the interconnected but interdependent structure of the dual systems (Paivio, 1991).

Based on the theoretical foundation of dual coding theory, there have been two main findings from studies that have looked at verbal and nonverbal processing (Mayer & Anderson, 1991; Mayer et al., 2001; Sadoski & Paivio, 2001; Schnotz, 2001). The first main finding suggests that processing information both verbally and visually can lead to greater learning, retention, and transfer than processing information verbally (Clark & Paivio, 1991). The second main finding suggests that verbal and nonverbal channels are subject to capacity limitations and may be overloaded (Doolittle et al., 2005). Sweller's (1988) cognitive load theory (CLT) considers these capacity limitations.

Cognitive Load Theory

Based on the findings of the limited capacity and duration of working memory (Baddeley, 1986; Miller, 1956; Peterson & Peterson, 1959) cognitive load theory (CLT) was developed when Sweller (1988) was studying problem solving. CLT has been a popular topic and research focus over the past sixty years (Cooper, 1990; Corbalan et al., 2006; Corbalan et al., 2008; Kirschner, 2002; Kirschner et al., in press; Pollock et al., 2002; Sweller, 1988; Sweller, 1994; Sweller et al., 1998; Sweller et al., 2019; van Merriënboer & Ayres, 2005; van Merriënboer & Sweller, 2005). A heavy emphasis was placed on problem-solving (Dewey, 1910;

Dewey, 1916) and as a result of this, researchers began studying problem solving. Since Sweller (1988) developed CLT while studying problem solving, the theory has increased in popularity. Many theorists and educational institutions have focused on problem-solving skills, particularly in math and science, for a large portion of the last century as problem-solving skills are highly valued (Sweller, 1988).

Sweller (1988) found that novices, or learners with no prior knowledge, use weak methods, such as means-end analysis, to solve typical problems. These weak methods combined with the intrinsic complexity of the information (or problem) in the learning task may impose excessive cognitive load on the learner. CLT suggests a human's limited processing capacity of working memory contributes to cognitive load imposed on a learner (Sweller, 1994). CLT explains there are three types of demand, or load, on cognitive processing capacity: extraneous, intrinsic, and germane (Sweller, 1994).

Extraneous load is any cognitive processing that does not supporting the learning objectives (Sweller, 1994). This type of load is usually created through the learning environment and instructional design, such as presenting too much information at once, (Sweller, 1994). Intrinsic load is the cognitive effort exerted to process the relevant material at the natural complexity level of the content. (Sweller, 1994) This is measured by how many items the learner must process simultaneously to complete a task. Lastly, Sweller believes germane load is aimed at deeper understanding and is created to motivate the learner to make sense of the material. This load type can be supported by instructional methods that facilitate learner engagement with the material (Sweller, 1994).

It may be expected that cognitive load is correlated with the number of items that must be held in working memory (Sweller, 1988). Based on Miller's (1956) and Peterson and Peterson's

(1959) findings on the limited capacity of working memory, any problem that requires many items to be held in working memory at once may result in excessive cognitive load (Sweller, 1988). If the strategy takes most of the learner's cognitive processing capacity, then there will be less cognitive processing capacity for other aspects of the task (Sweller, 1988).

Developing problem solving skills requires schema acquisition (Sweller, 1988). To help manage the learners' cognitive load, Sweller (1988) noted schema acquisition, elaboration, and automation can reduce working memory's capacity limitations. Schema acquisition is described now. Elaboration and automation are described in later sections.

The human cognitive architecture creates schemata to help combat the issue of excessive cognitive load (Pollock et al., 2002). A schema is "a cognitive construct that organized elements of information categorically and stores them in long-term memory" (Pollock et al., 2002, p. 63). Schemata organize and store information in chunks. This allows working memory to process each chunk as one item, which frees up capacity for more new items to be processed (van Merriënboer & Ayres, 2005).

As mentioned earlier, Sweller (1988) found that novices use weak methods (means-end analysis) to solve typical problems. There are two main reasons why conventional problem-solving techniques, like means-end analysis, are ineffective (Sweller, 1988). These reasons are selective attention and cognitive processing capacity. Selective attention is referred to as the processes that enable an individual to select and attend to certain pieces of incoming information while simultaneously filtering out extraneous information (Sweller, 1988). Problem solving and acquiring schemata requires unrelated cognitive processes (Sweller, 1988).

To solve a problem when using means-ends analysis, a problem solver must attend to a dissonance between the actual state and desired state (Sweller, 1988). Sweller states, "Previously used problem-solving operators can be totally ignored by problem solvers using this strategy under most conditions. Previous states and operators need to be noted only to prevent retracing steps during solution" (p. 261). These processes can be compared to schema acquisition (Sweller, 1988). A problem solver must learn to assimilate a problem state with a particular category of problem states that requires a certain set of decisions to build schemata (Sweller, 1988). It may be expected that giving attention to previous problem states and decisions associated with those states are important parts of schema acquisition (Sweller, 1988). When using means-ends analysis, the cognitive processes related to schema acquisition may be ignored.

The next reason Sweller (1988) mentioned for ineffective problem-solving techniques is cognitive processing capacity. The term human cognitive architecture refers to the way cognitive structures are organized in the brain (Sweller, 2003). The human cognitive architecture has limited cognitive processing capacity in both size and duration (Miller, 1956; Peterson & Peterson, 1959). Based on the findings of Miller (1956) and Peterson and Peterson (1959), working memory is a bottleneck due to its limited capacity (van Gog & Paas, 2008). If a problem solver devotes all their cognitive capacity to attaining their goal, there is no free capacity for schema acquisition; therefore, the learner didn't learn or retain the relevant and necessary instructional content (Sweller, 1988).

With these considerations in mind, working memory limitations combined with the natural complexity of the information in the learning task may impose a high cognitive load on the learner. CLT suggests that instructional materials that direct cognitive capacity to activities that are important to learning can result in more meaningful learning (Cooper, 1990). Meaningful learning is defined as "a deep understanding of the material, which includes attending to important aspects of the presented material, mentally organizing it into a coherent cognitive structure, and integrating it with relevant existing knowledge" (Mayer & Moreno, 2003, p. 43). In order for meaningful learning to occur, learners must actively engage with the material and cognitively process the information; therefore, a learner's limited cognitive processing capacity and duration combined with the complexity (structure) of the information presented can impact meaningful learning.

The structure of information and the human cognitive architecture are considered by CLT. Considering these aspects helps instructional designers to promote understanding, learning, and problem-solving (Pollock et al., 2002). With the previous considerations in mind, there are four main assumptions of CLT. First, humans have a limited processing capacity (Miller, 1956). Second, an unlimited long-term memory helps overcome the limitations of working memory (Sweller, 1988). Third, information is structured and organized in schemata that are held in long term memory (Chi et al., 1982; Larkin et al., 1980). These schemata reduce the load imposed on working memory. Finally, schemata can be processed automatically through a process called automation (Kotovsky et al., 1985; Schneider & Shiffrin, 1977; Shiffrin & Schneider, 1977). According to these authors, automation also reduces the load imposed on working memory.

Automation allows information to be processed with no conscious effort, which decreases working memory load (Sweller, 2003). An important part of schema construction is automation (Sweller et al., 1998). Information can be processed either consciously or automatically (Schneider & Shiffrin, 1977; Shiffrin & Schneider, 1977). According to these authors, conscious processing is similar to the process described above with limitations of working memory; however, automatic processing mostly bypasses working memory. Automation allows information to be processed with minimal working memory demands, which frees working memory capacity to process other important chunks of information (Sweller & Chandler, 1994; Sweller et al., 1998).

Research suggests that schema acquisition and automation are essential when considering cognitive activities (Sweller, 1988) According to Sweller, instructional techniques that do not promote schema acquisition and automation are ineffective because they often require processing capacity that is beyond working memory's limitations. According to Sweller (1988), as learners integrate simple and complex ideas, expertise is developed. For example, a chess expert can combine the best moves for individual pieces with complex schemata for how several pieces should be placed together (Sweller, 2005). van Merriënboer and Ayres (2005) said,

> Human expertise comes from knowledge stored in cognitive schemas, not from an ability to engage in reasoning with many new elements yet to be organized in long term memory. It is through the – often conscious and mindful – construction of increasing numbers of ever more complex schemas, and through the automation of some of these schemas, that expertise develops.

As a result of limited working capacity, the design of instruction should allow working memory to process the information (Kirschner, 2002). CLT suggests that effective instruction directs cognitive resources towards relevant activities rather than supplemental processes to learning, like weak problem solving methods (Cooper, 1990). According to Cooper, this allocation of cognitive resources promotes learning. CLT attempts to explain how learners' ability to process new information and construct knowledge in long-term memory is affected by the load imposed on the learner by processing information (Sweller et al., 2019).

It is important that instructional design considers how learners can construct and automate schemata to develop knowledge and expertise (Sweller, 1994). One factor that instructional designers should consider is the difficulty of the topics and tasks that need to be learned (Sweller, 1994).

Sweller (1994) considered factors that influence the difficulty of the topics and tasks that need to be learned. The interaction between the nature of the content being learned and the expertise of the learner determines the imposed intrinsic cognitive load (van Merriënboer & Ayres, 2005). According to these authors, intrinsic load primarily depends on the number of items that must be processed simultaneously in working memory. Cognitive load and the extent to which the elements in the information interact with one another are strongly associated (Sweller and Chandler, 1994). According to these authors, the extent to which elements interact is referred to as element interactivity. Element interactivity can be either low or high (Sweller & Chandler, 1994; Sweller, 2003). Sweller & Chandler (1994) noted, “Learning difficulty is not just a function of the number of elements that must be learned but also a function of the number of elements that must be process simultaneously” (p. 189). The number of items that must be processed simultaneously depends on the element interactivity of the material (van Merriënboer & Ayres, 2005); therefore, the level of element interactivity has effects on cognitive load (Sweller, 1994; Sweller, 2003; Sweller & Chandler, 1994; van Merriënboer & Ayres, 2005).

A high level of element interactivity may increase cognitive load because many interacting elements must be held in working memory and processed simultaneously (Sweller & Chandler, 1994). Information that must be “understood” rather than “learned” consists of high element interactivity (Sweller, 1994). When schemata have been acquired that are associated with high element interactivity, learners feel they understand the content; however, when the schemata are automated, they understand the content very well. Effects of low element interactivity may result in non-existent or weak results (Sweller, 1994).

Instructional designers who incorporate certain design considerations for low element interactivity may be utilizing features that have no impact because the content is not complex enough to overload the learners' working memory (Sweller, 2003). According to Sweller, CLT may not be applicable to low element interactivity. Elements that do not interact with one another and can be learned without reference to other elements, or independently, have low or no element interactivity. Learning these elements impose very little cognitive load on the learner since they can be learned independently, without reference or connection to other elements (Sweller 2003).

Some information is naturally complex (Pollock et al., 2002). As a result of the complexity, a heavy load will be imposed on working memory, regardless of instructional design considerations. Sweller et al., (1998) originally believed that instruction could not adjust intrinsic load because complex information with high element interactivity could not be understood without processing all items together. Pollock et al., (2002) discovered a gap in CLT and hypothesized that intrinsic load could be artificially reduced.

A study conducted by Pollock et al., (2002) provided evidence that instructional designers can adjust intrinsic load by reducing the level of element activity. According to Pollock et al., artificially reducing intrinsic load is possible and sometimes beneficial. Sweller's (1998) original belief is still appropriate because understanding is reduced by artificially reducing intrinsic load (Pollock et al., 2002). Full understanding requires presenting the content in its full complexity, with its natural level of element interactivity. In order for the learner to be able to process the information automatically, schemata must be constructed (Pollock et al., 2002).

Pollock et al., (2002) hypothesized that learning some elements may increase a learner's understanding as a schema is built. Four experiments were conducted. Experiments one and three predicted that isolating elements followed by interacting elements would be more effective than repeated exposure of interacting elements. Experiments two and four predicted that if schemata were already established, isolating elements were unnecessary (Pollock et al., 2002). The results from these studies provided strong evidence for their hypotheses with certain groups of learners (Pollock et al., 2002).

According to Pollock et al., (2002), experiments one and three provided evidence that novice learners benefited from learning isolated elements prior to learning about interacting elements. Experiments two and four showed no evidence that learning isolated elements first was more effective than continuous exposure to interacting elements. A difference in learner expertise could have been a possible contributor to the difference in results between experiments one and three and experiments two and four (Pollock et al., 2002). Ultimately, CLT assumes that considering the interaction between the human cognitive architecture and the structure of the information is important for humans to effectively understand and learn (Pollock et al., 2002).

The main goal of cognitive load research is to better understand the best conditions for learning (Kirschner et al., in press). The goal is to promote skills that allow learners to apply their acquired knowledge to new and familiar problem-solving situations (Kirschner et al., in press). Sweller and Chandler (1994) anticipated that it would be harder for a learner to process new information that contained a lot of information versus new information that contained less information.

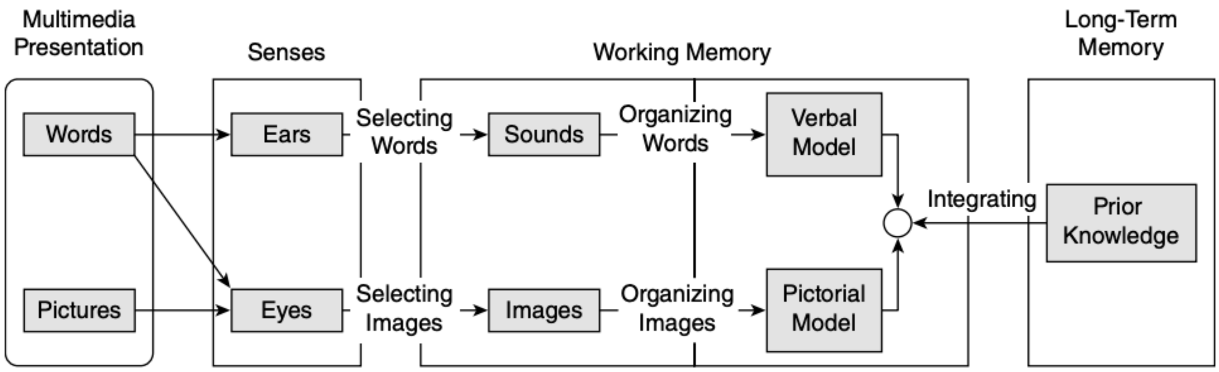
The limitations of the human cognitive system have consequences for the design and delivery of the instructional information (Sweller, 1988; Sweller & Chandler, 1994). A major challenge in designing multimedia lessons is being sensitive to a learner's cognitive load during learning (DeLeeuw & Mayer, 2008). An example of this challenge is an electric motor lesson (Mayer, 2005; Mayer, 2021; Mayer & Moreno, 2003; Sweller, 1999; Sweller, 2005). An electric motor lesson should be designed to manage the amount of cognitive processing required for the learner so the instruction does not exceed the learners' processing capacity, at any given time (DeLeeuw & Mayer, 2008). Based on the research described in the DCT and CLT sections, these constructs provide support for the main assumptions of the cognitive theory of multimedia learning (CTML) (Clark & Mayer, 2016; Mayer, 2003; Mayer, 2021).

Cognitive Theory of Multimedia Learning

Cognitive science principles that demonstrate how to use instructional design and technology for effective learning have contributed to e-learning theory (He, n.d.). One specific part of e-learning theory is multimedia learning (He, n.d.). Using two formats to present information, such as a combination of audio, visual, and text instead of one or all three can promote deeper learning (He, n.d.). This assumption is a foundation of the cognitive theory of multimedia learning (CTML) (Clark & Mayer,2016; Mayer, 2021). The CTML seeks to explain how learning happens in a multimedia environment (Mariano, 2014). This author notes "Specifically, the theory focuses on how words and pictures are selected, organized, and integrated to form meaningful learning" (p. 1). The CTML is shown in Figure 4 below.

Figure 4

Cognitive Theory of Multimedia Learning (CTML)



Note. Figure 2.1. Cognitive theory of multimedia learning. From "*e-Learning and the science of instruction: Proven guidelines for consumers and designers of multimedia learning*, by R. C. Clark & R. E. Mayer (2016). Wiley. The permission to provide a copy of this figure in this paper is shown in Appendix A: Permissions.

The CTML considers how humans process information to create meaningful learning (Mayer, 2021). Mayer stated, "principles of multimedia instructional design should be sensitive to what we know about how people process information during learning" (p. 33). CTML combines three different theories: Baddeley's (1986) working memory model, Paivio's (1971) dual-coding theory, and Sweller's (1988) cognitive load theory. Using these theories as a foundation, CTML has three main assumptions: dual-channel processing, limited capacity, and active processing assumptions (Clark & Mayer, 2019; Mayer, 2005; Mayer, 2021). Each of these three assumptions are discussed in further detail in the following three sections.

Dual Channel Processing Assumption

The dual channel processing assumption assumes there are two separate channels that process auditory and visual information (Mayer, 2021). Since Baddeley's (1986) and Paivio's

(1971) interpretation of dual channels is different, Mayer compromised between the two. Mayer (2005) explained,

> For purposes of the CTML, I have opted for a compromise in which I use the sensory modality approach to distinguish between visually presented materials (e.g., pictures, animations, video, and on-screen text) and auditorily presented material (e.g., narration and background sounds) as well as a presentation-mode approach to distinguish between the construction of pictorially based and verbally based models in working memory. (p. 34)

This dual channel assumption proposes the human information processing system has two channels: an auditory/verbal channel and a visual/pictorial channel. Information enters the human information system through one of the two channels (Mayer, 2021). The ears and eyes recognize the words and pictures presented in the instruction. These senses select words and images that are then held in working memory. Working memory organizes the words to create a verbal model of the presented information. Working memory also organizes the images to create a pictorial model of the presented information. These models are then integrated with prior knowledge retrieved from long term memory. New information is added to the information retrieved from long term memory and adds to the learner's knowledge.

The concept of dual channels considers, at a broad level, how information is perceived, recognized, and input into the human processing system. Mayer's (2021) approach explains how multimedia processing occurs using both channels. The two channels accommodate for the limited capacity of each channel, which leads to the second assumption of CTML.

Limited Capacity Assumption

The limited capacity assumption assumes either of the dual channels previously described are limited to the amount of information, or load, they can process at one time (Mayer, 2021). This assumption is based on Miller's (1956) limited capacity and Peterson and Peterson's (1959) limited duration findings, as well as Baddeley's (1986) working memory model and Sweller's (1988) CLT. It is assumed there is a dual channel system with limited capacity that can be overloaded by incoming information or the demand of a certain task (Mayer, 2021).

Mayer (2021) believes a learner's working memory can hold and process a few elements of information during multimedia instruction; therefore, utilizing two channels can help manage the learner's cognitive load. Miller (1956) originally believed the average learner could hold seven plus or minus two chunks of information in working memory at once; however, according to Cowan (2000) and van Merriënboer and Sweller (2005), a learner can only process three to five elements of information at once. These authors believed fewer elements could be processed because the capacity of working memory shrinks as the size of the chunk of information increases. In order for learning to happen and schemata to be built, learners must actively engage in cognitive processing, which uses cognitive resources (Clark & Mayer, 2016; Mayer, 2021). The active processing assumption is the third assumption of CTML (Clark & Mayer, 2016; Mayer, 2021).

Active Processing Assumption

The active processing assumption assumes learners must actively engage in cognitive processing to build schemata (Mayer, 2021). According to Mayer, learners can actively engage in learning through attending to, organizing, and integrating information. First, learners must select relevant pieces of information to be processed. Then, they must organize the information and integrate the new information with prior knowledge retrieved from long term memory (Mayer, 2005).

When a learner actively engages with the material, they can construct a mental model, select relevant information, and organize the information in a logical manner (Mayer et al., 2002). According to Mayer (2005) and van Merriënboer and Kester (2005), instruction should be designed to guide the learner to develop their own mental model. Learners must interact and engage with the material to create that mental model (Mayer, 2021).

In summary, the foundation of CTML is based on these three assumptions. These assumptions create a basis for instructional design considerations for multimedia instruction. The CTML includes several principles that are based on these three assumptions. These principles consider what is known about the human cognitive architecture and limitations of working memory to help promote meaningful learning (Clark & Mayer, 2016; Mayer, 2005; Mayer, 2021). Three of the several principles have shown evidence to help manage intrinsic load (foster essential processing): the modality, pretraining, and segmenting principles (Fiorella & Mayer, 2012; Gegner et al., 2009; Ginns, 2005; Harskamp et al., 2007; Lee & Mayer, 2018; Low & Sweller, 2014; Mautone & Mayer, 2007; Mayer & Chandler, 2001; Mayer & Moreno, 1998; Mayer & Moreno, 1999; Mayer & Pilegard, 2014; Mayer et al., 2002; Mayer et al., 2003; Mayer et al., 2018; Mayer et al., 2019; Moreno et al., 2001; Moreno & Mayer, 2002; O'Neil et al., 2000; Pilegard & Mayer, 2016; Pilegard & Mayer, 2018; Sung & Mayer, 2013). Each of these principles are described in detail below.

Modality

The modality principle states, "People learn more deeply from pictures and spoken words than from pictures and printed words" (Mayer, 2021, p. 281). Modality is directly related to the dual channel assumption which assumes humans have two separate channels that can process information: one channel for visual/pictorial information and one channel for auditory/verbal information (Mayer, 2021). According to Mayer, presenting words as narration instead of onscreen text is a useful technique for managing intrinsic load. This technique is referred to as modality offloading (Mayer, 2021). Instructional designers can offload some essential cognitive processing from the visual channel to the auditory channel (Mousavi et al., 1995), which can decrease the load on one channel.

The modality principle has been the most researched multimedia principle and has provided the most research evidence out of the multimedia principles described by Clark and Mayer (2016). Many researchers have studied the modality principle and its effect on learning (Ginns, 2005; Harskamp et al., 2007; Lee & Mayer, 2018; Low & Sweller, 2014; Mayer et al., 2003; Mayer et al., 2019; Mayer & Moreno, 1998; Mayer & Moreno, 1999; Mayer & Pilegard, 2014; Moreno et al., 2001; Moreno & Mayer, 2002; O'Neil et al., 2000). Mayer (2021) looked at research on the modality principle and synthesized core evidence found for the modality principle. The median effect size of 19 experiments was 1.00 (Mayer, 2021). These experiments included different types of content, including lightning, brakes, an aircraft simulation, environmental science game, electric motor, biology, geography, and Antarctica lessons (Harskamp et al., 2007; Lee & Mayer, 2018; Mayer & Moreno, 1998; Mayer et al., 2003; Mayer et al., 2019; Moreno & Mayer, 1999; Moreno & Mayer, 2002; Moreno et al., 2001; O'Neil et al., 2000). Findings from these studies showed promising support for the modality principle (Mayer, 2021).

Although the modality principle is supported in research, there are certain conditions under which the principle does not apply (Ginns, 2005; Kalyuga et al., 1999; Lee & Mayer, 2018; Mayer & Pilegard, 2014; Mayer et al., 2019; Tabbers et al., 2004; Tindall-Ford et al., 1997; Wong et al., 2012). The reverse modality effect occurs when instruction with visual only elements is superior to instruction with audio-visual elements (Leahy & Sweller, 2011). According to these authors, there are certain conditions under which the modality effect will not be obtained or may even be reversed. These are referred to as boundary conditions (Mayer, 2021).

There are four boundary conditions that affect when the modality principle does and does not apply. These boundary conditions are pacing of the lesson, language skill of learner, complexity of the lesson, and the type of test. Mayer (2021) suggests modality is mainly applicable to a multimedia lesson that provides no learner control for a fast paced, complex topic, that uses familiar words, and assesses transfer. Because there are times when the modality principle is weaker and may not apply, there are situations when printed text (no use of modality) can foster meaningful learning (Leahy & Sweller, 2011, Mayer, 2021). These situations may include a slow-paced lesson, when the learner has control over the lesson advancement, when unfamiliar words are used, or when the lesson is in a learner's second language.

Overall, the modality principle provides an important suggestion to instructional designers: "When making a multimedia presentation consisting of animation and words, present the words as narration rather than on screen text" (Mayer, 2021, p. 296). With boundary conditions in mind, this suggestion is mainly applicable to a multimedia lesson that provides no learner control for a fast-paced, complex lesson that uses familiar words and assesses transfer (Mayer, 2021). Ultimately, modality matters and should be considered within the context of how humans process information.

Pretraining

The pretraining principle states, “People learn more deeply from a multimedia message when they know the names and characteristics of the main concepts” (Mayer, 2021, p. 265). According to Mayer, pretraining reduces the amount of processing required to understand information by providing prior knowledge. Researchers have found evidence that prior knowledge is one of the most important considerations for individual differences in instructional design (Chandler & Sweller, 1991; Paas et al., 2003; Sweller, 2003; van Gog & Paas, 2008).

Many researchers (Fiorella & Mayer, 2012; Gegner et al., 2009; Mayer & Chandler, 2001; Mayer et al., 2002; Pilegard & Mayer, 2016; Pilegard & Mayer, 2018) have studied the pretraining principle and its effect on learning. Mayer (2021) looked at research on the pretraining principle and provided core evidence that supports the principle and its effect on learning. The median effect size of ten experiments was 0.78 (Mayer, 2021). These experiments focused on different topic areas such as a car braking system, using a tire pump, a geology game, finding research articles, and using games for geology, electricity, physics, and spatial skills (Fiorella & Mayer, 2012; Gegner et al., 2009; Mayer et al., 2002; Mayer et al., 2002; Pilegard & Mayer, 2016, Pilegard & Mayer, 2018). Findings from these studies favor the pretraining principle and its effect on learning (Mayer, 2021).

Researchers have found conditions in which the pretraining principle is less effective (Clark et al., 2005; Pollack et al., 2002; Kester et al., 2004; Kester et al., 2006). Pretraining works best when novices are learning fast paced, complex material (Mayer, 2021). The underlying premise of the pretraining principle is that learners may not have free memory capacity to make sense of the information or process the information because their memory capacity is used to understand names and characteristics of the new items (Mayer, 2021).

According to Mayer, providing the opportunity for learners to build knowledge about key words and characteristics can free up memory capacity to process and enable them to make sense of the complex information. The next principle described by Mayer (2021) to manage intrinsic load is the segmenting principle. Essentially, pretraining and segmenting break up the content in different ways.

Segmenting

The segmenting principle states, “People learn better when a multimedia message is presented in user-paced segments rather than a continuous unit” (Mayer, 2021, p. 247). Segmenting is another technique used to manage essential processing (Mayer, 2021). According to Mayer, there are two key components of segmenting: first, breaking a lesson into meaningful chunks and second, allowing the learner to control the pace of instruction.

Clark and Mayer (2016) note that very little is known about how big a segment should be and how much information should be included in a segment. These authors ask, “Should a segment last for ten seconds, thirty seconds, sixty seconds, or more” (p. 214)? Mayer (2021) noted the ideal size of a segment is still an important question that warrants further research. According to Mayer, little is known about what determines an ideal segment, although the segmenting principle, in general, has shown evidence to help manage intrinsic load.

Many researchers (Mayer & Chandler, 2001; Mautone & Mayer, 2007; Mayer et al., 2003; Mayer et al., 2018; Mayer et al., 2019; Sung & Mayer, 2013) have studied the segmenting principle and its effect on learning. Mayer (2021) looked at the research on segmenting and the core evidence for the principle. The median effect size for seven studies was 0.67 (Mayer, 2021). These experiments were conducted for a variety of different topics, such as lightning, an electric motor, erosion, solar cells, and geography lessons (Mayer & Chandler, 2001; Mayer et al., 2003;

Mayer et al., 2018; Mayer et al., 2019; Mautone & Mayer, 2007; Sung & Mayer, 2013). The findings from these studies show favorable evidence for the segmenting principle.

There are certain conditions that may not be affected by segmenting (Ayres, 2006; Chen & Yen, 2019; Lusk et al., 2009; Mayer & Pilegard, 2014; Rey et al., 2019; Spanjers et al., 2011). Segmenting works best when learners are presented with a fast paced, complex lesson (Mayer, 2021). Prior knowledge and working memory capacity may have an effect on segmenting (Ayres, 2006; Lusk et al., 2009; Mayer & Pilegard, 2014; Rey et al., 2019; Spanjers, 2011). Including segmenting allows learners to process information before moving on to the next segment (Clark & Mayer, 2016). Breaking a complex lesson into manageable parts can help learners process the information with their available cognitive processing capacity (Mayer, 2021).

To determine how well these multimedia principles work, recall and transfer of learning can be assessed after the instructional content is presented. These two types of learning are described in the following sections.

Recall

When information is recalled, it means the information is retrieved from long-term memory and recognized in working memory (Andrew & Bird, 1938). Mayer (2021) refers to recall as retention. In some cases, the goal is to have learners recall what they learned (Mayer, 2021). Testing recall shows what information has been transferred to long-term memory. Although it is important to be able to recall what has been learned, learners also need to be able to transfer the information they have learned to similar and different problems and situations (Mayer, 2021). Assessing transfer goes beyond what can be remembered and focuses on information that can be used in other situations or for other problems.

Transfer

The early investigation of transfer began in the early decades of the 20th century (Thorndike, 1923; Thorndike & Woodworth, 1901). Thorndike (1923) hypothesized that studying Latin prepared learners for better performance in other subject areas by disciplining the mind. There were no findings that Latin studies were useful, as learners who had not taken Latin studies performed the same as learners who had taken Latin studies (Thorndike, 1923). Other experiments, such as Thorndike and Woodworth (1901), found no positive impact for one type of learning versus another. Thorndike (1923) believed transfer was dependent on identical elements in two different situations. According to Thorndike, the foundation of the identical elements assumption was if two situations were not similar enough (too different) much transfer should not be expected.

According to Perkins and Salomon (1992), transfer "occurs when learning in one context or with one set of materials impacts performance in another context or with other related materials" (p. 3). Transfer is an important topic in learning and education because learning seeks to enable learners to apply learned information to different situations and problems (Anderson et al., 1996). According to Perkins and Salomon (1992), there are different types of transfer. There is positive versus negative transfer and near transfer versus far transfer. Font and Nisbett (1991), Mayer (1991), and Mayer and Chandler (2001) describe immediate versus delayed transfer.

Positive transfer is shown when learning in one situation improves performance in another situation (Perkins & Salomon, 1992). According to Perkins and Salomon, negative transfer is shown when learning in one situation negatively impacts, or diminishes, performance in another situation. On the other hand, near transfer is referred to when transfer happens between very similar situations and far transfer occurs between two very different situations (Perkins & Salomon, 1992).

In multimedia learning literature, knowledge transfer is represented by how well a learner can transfer basic cause and effect knowledge to similar problems or situations (Hummel et al., 2004; Mayer & Moreno, 1998). Transfer in multimedia learning is usually measured through problem-solving questions (Mayer, 1999; Mayer & Chandler, 2001). Immediate transfer is usually observed in multimedia learning, where learners take a test immediately following the instruction (Mayer, 1999; Mayer & Chandler, 2001; Mayer & Moreno, 1998). The downside to measuring only immediate transfer is there is no evidence that multimedia learning provides sustained, long-term transfer (Mariano, 2014). Delayed transfer can also be assessed, by providing an assessment after a period of time following the instruction, such as a few days, weeks, or even months (Fong & Nisbett, 1991). Recommendations for delayed transfer will be discussed in Chapter V.

Future Research

The existing literature suggests e-learning and technology can enhance learning and instruction. The impact of technology on learning remains a question. The field can benefit from research that focuses on strategies and techniques that facilitate learning in an online environment and in what conditions these strategies and techniques work (Clark & Mayer, 2021; He, n.d.; Mariano, 2014; Mayer, 2021). Determining the impact technology has on multimedia learning could provide sustainable insight for practitioners to help them effectively and efficiently facilitate learning in online environments. Although there has been a lot of research conducted on multimedia learning, there are still areas that require further research.

Three multimedia principles described by Clark & Mayer (2016) have been studied individually to manage intrinsic load. Although the research has shown evidence to support these principles and their effect on managing intrinsic load, there are still areas that require further research (Mayer, 2021). Regarding the modality principle, much research has studied the modality principle to see if it works (Mayer, 2021). The research base has shown evidence that modality can manage intrinsic load (Ginns, 2005; Harskamp et al., 2007; Lee & Mayer, 2018; Low & Sweller, 2014; Mayer et al., 2003; Mayer et al., 2019; Mayer & Moreno, 1998; Mayer & Moreno, 1999; Mayer & Pilegard, 2014; Moreno et al., 2001; Moreno & Mayer, 2002; O'Neil et al., 2000). Now, the research on the modality principle is shifting to identify boundary conditions (Mayer, 2021). According to Mayer, more research is needed on what conditions affect the modality principle, both positively and negatively, and the implications those conditions have on CTML.

Regarding the pretraining principle, research is still needed on how to best pretrain novice learners on vocabulary and characteristics of key items (Mayer, 2021). Mayer also noted more research is needed on how to assess learner's prior knowledge to embed the right level of pretraining in the lesson for each learner. Last, much is still unknown about how to make sure students are not cognitively overloaded throughout a fast-paced lesson when they are trying to figure out key terms (Mayer, 2021).

Regarding the segmenting principle, Mayer (2021) notes that research is still needed to determine "the relative effectiveness of CONTINUE buttons or arrow keys based on instructor-determined segments versus PAUSE/CONTINUE buttons and slider bars for user-determined segments" (p. 261). Research is also still needed to determine how the segmenting principle is affected by the complexity of the information and the pace of the presentation (Mayer, 2021).

Mayer noted the final area that requires further research for the segmenting principle is the ideal length of a segment and what constitutes the ideal length.

In addition to further research needed on pretraining, segmenting, and modality individually, they have never been studied in combination. Based on the supporting evidence shown about each of the three principles individually, a simple conclusion is to use multiple principles because they have shown evidence to improve learning (Cheon et al., 2013; Lawson & Mayer, 2021; Lusk et al., 2008; Mariano, 2014; Mayer & Chandler, 2001; Mayer et al., 2002; Mayer et al., 2017; Mayer et al., 2018; Moreno, 2007; Rey et al., 2019; Schroth, 2000). However, outside of research settings, real world instructional designers deal with time and money constraints. Is a combination of the principles (pretraining and modality or segmenting and modality) better than pretraining, segmenting, and modality, or modality only? Is using only one principle sufficient enough to manage intrinsic load? These questions still remain unanswered and are not addressed in the existing literature.

Summary

The field of instructional design is still relatively new (Dick, 1987) and has many questions that remain unanswered. There have been a lot of research syntheses and an expansion of literature by many researchers on how the human cognitive system works and how it processes information. Although researchers have been looking at how humans process information for a while, this research has not always been considered when designing instructional materials (Khan, 2002; Reigeluth, 1983; Reiser, 2001; Richardson et al., 2019). The development of the PC and internet created new paradigms in education (Collis, 1996). As technology advanced, more educators integrated technology into learning without considering how to effectively use technology to promote learning.

eLearning has changed the way we analyze, design, develop, and implement learning solutions (Chernev, 2022; Clark, 2005; Clark & Mayer, 2015; Collis, 1996; Khan, 2002; Muniasamy & Alasiry, 2020; Pontefract, 2019; Wang, et al., 2011). Integrating theories such as the working memory model, DCT, and CLT into multimedia learning theory has allowed educators and practitioners to create and deliver more efficient and effective online instruction. These theories have added to the idea that we need to reduce extraneous load, manage intrinsic load, and foster germane load to facilitate meaningful learning (Clark & Mayer, 2016).

Studies (Clark & Mayer, 2016; Khan, 2002; Pontefract, 2019; Wang et al., 2011) have shown technology should never be used just to use technology. Technology needs to have a purpose. Clark and Mayer (2016) cautioned in order for technology to promote learning, technology must be used in a way that supports human cognitive learning processes. The use of technology does not guarantee learning (Clark & Mayer, 2016). Khan (2002) noted that using the web as a delivery channel for instruction requires a careful analysis and investigation on how to best align instructional design principles with the design and implementation of instruction. Researchers that have looked at the CTML and multimedia principles described by Clark and Mayer (2016) have added to the literature on effective multimedia design.

By comparing multiple CTML principles that manage intrinsic load (Clark & Mayer, 2016; Mayer, 2021), this research study adds new understanding to the field. The purpose of this experimental study was to test if learners recalled and transferred a new concept better by managing intrinsic load using multiple CTML principles (segmenting, pretraining, and modality), two pairs of principles (pretraining and modality or segmenting and modality) or a single principle (modality).

CHAPTER III

Methods

The purpose of this experimental study was to test if learners learned a new concept more effectively by managing intrinsic load using three CTML principles (segmenting, pretraining, and modality), two pairs of principles (pretraining and modality or segmenting and modality), versus a single principle (modality). Since modality is central to multimedia learning (Clark & Mayer, 2016; Mayer, 2021), it was held constant in the positive for all four treatment groups. The use of segmenting and pretraining varied in the treatment groups. By comparing multiple CTML principles that manage intrinsic load (Clark & Mayer, 2016; Mayer, 2021), this research study hoped to add new understanding to the instructional design field for multimedia learning principles. Researchers (Cheon et al., 2013; Clark & Mayer, 2016; Clark et al., 2005; Eitel et al., 2013; Lawson & Mayer, 2021; Lusk et al., 2008; Lusk et al., 2009; Mariano 2014; Mayer & Chandler, 2001; Mayer & Pilegard, 2014; Mayer et al., 2017; Mayer et al., 2018; Moreno, 2007; Rey et al., 2019; Schroth, 2000) have studied the effects of pretraining, segmenting, and modality individually, but have not determined if combinations of these principles help achieve better learning outcomes.

Research Questions

The guiding research questions are repeated below:

1. Do any of the four combinations of the use/non-use of the pretraining and segmenting principles, combined with modality, cause an increase in college learners' overall scores for an online test of consumer decision-making knowledge?

Research hypotheses for question 1:

H_0: There is no significant difference in overall posttest scores between the PSM, PM, SM, and M groups.

H_1: There is at least one significant difference in overall posttest scores between the PSM, PM, SM, and M groups.

2. Do any of the four combinations of the use/non-use of the pretraining and segmenting principles, combined with modality, cause an increase in college learners' recall scores for an online test of recall of consumer decision-making knowledge?

Research hypotheses for question 2:

H_0: There is no significant difference in posttest recall scores between the PSM, PM, SM, and M groups.

H_1: There is at least one significant difference in posttest recall scores between the PSM, PM, SM, and M groups.

3. Do any of the four combinations of the use/non-use of the pretraining and segmenting principles, combined with modality, cause an increase in college learners' transfer scores for an online test of transfer of consumer decision-making knowledge?

Research hypotheses for question 3:

H_0: There is no significant difference in posttest transfer scores between the PSM, PM, SM, and M groups.

H_1: There is at least one significant difference in posttest transfer scores between the PSM, PM, SM, and M groups.

Research Design

An experimental, randomized, posttest only, control group design was used in this study, shown in Table 1 (repeated below). This study included two independent variables: pretraining and segmenting and one dependent variable: posttest score. The posttest score consisted of 10 recall and 10 transfer questions. Overall test scores were analyzed to see if there was a difference in test scores among the four treatments. Recall and transfer scores were also analyzed to see if there was a difference in recall and transfer scores among the four treatments. The experimental design was a 2x2 factorial analysis of variance (ANOVA) design with pretraining (use, nonuse) and segmenting (use, nonuse) as between subject variables.

Table 1

Research Design for the Proposed Study

Group	Random Assignment	Treatment	Posttest	Demographic Survey
PSM Pretraining and segmenting with modality	R	X_3	T_1	S_1
PM Pretraining with modality	R	X_2	T_1	S_1
SM Segmenting with modality	R	X_1	T_1	S_1
M Modality	R	X_0	T_1	S_1

Note. R indicates random assignment to groups. X_x represents the treatment groups, T_1 represents the cognitive posttest, and S_1 represents the demographic survey.

Participants were randomly assigned to one of the four treatment groups. Immediately following the treatment, a posttest was administered. Each group received the same content and posttest; however, the order or way in which the content was presented varied among the four treatments.

Participants

For this study, the participants consisted of undergraduate learners either majoring in business or exploring being a business major. The sample was taken from learners enrolled in an introductory business course (FIN1115: Personal Finance) at a medium size university in the Intermountain West. There were four sections of this course offered during the fall 2022 semester. There were no prerequisites to enroll in the participating institution's course.

Since the chosen course was an introductory level course, most learners were expected to be freshmen or sophomores. Research (Chandler & Sweller, 1991; Paas et al., 2003; Sweller, 2003; van Gog & Paas, 2008) on cognitive load has found evidence to support prior knowledge impacts the amount of load imposed on the learner because of existing schemata in long-term memory. Learners with a high level of prior knowledge could have impacted results of this study; therefore, prior knowledge about types of consumer decision making was considered an exclusion criterion for this study to better capture the amount of cognitive load imposed on the learners. If a learner had previously taken this course, they were excluded from the study. This data was captured at the end of the posttest with learner's consent. University and FIN 1115 demographics were used to describe the sample for generalizability purposes. These demographics are further discussed in Chapter IV.

The desired minimum sample size for each group was 30. A total sample size of at least 200 was desired; however, 120 participants was sufficient, as long as each group had a minimum of 30 participants. This will be further discussed in Chapters IV and V.

Treatments

There were four treatments in this study. The treatments were named by multimedia principles included in the treatment: modality only (M), segmenting with modality (SM), pretraining with modality (PM), and pretraining and segmenting with modality (PSM). Each of the four treatments are discussed in more detail in the paragraphs below.

The M treatment was used as the baseline comparison group and included modality only. The use of modality included both onscreen visual elements (i.e., tables, graphics, and animations) and audio narration. This treatment included one continuous lesson with activities (review questions) at the end of the entire lesson. The lesson auto advanced once the narration was finished on the presented slide. Participants learned the vocabulary, goals, and overall process throughout the continuous lesson rather than at the beginning.

Since the M treatment was defined as the baseline comparison group, modality was included in all four treatments to remove confounding variables and hold modality constant in the positive use. Modality is central to multimedia as Mayer (1997) mentioned multimedia learning presents information to learners in two or more formats, such as visual elements and narration. The dual processing assumption, central to CTML, assumes that two separate channels process auditory and visual information (Clark & Mayer, 2016; Mayer, 2021). Research (Clark & Mayer, 2016; Ginns, 2005; Harskamp et al., 2007; Lee & Mayer, 2018; Low & Sweller, 2014; Mayer, 2005; Mayer, 2021; Mayer & Moreno, 1998; Mayer & Moreno, 2002; Mayer & Pilegard, 2014; Mayer et al., 2003; Mayer et al., 2019; Moreno et al., 2001; Moreno & Mayer, 1999;

O'Neil et al., 2000) has shown evidence that narration with visual elements achieves better learning outcomes than onscreen text with visual elements because of the dual channel assumption and the split attention effect.

The SM treatment received a lesson that used the segmenting and modality principles. As previously stated, modality was held constant in all four treatments by including visual elements and narration instead of visual elements and onscreen text. This treatment had units that broke up (segmented) the instructional material. Segments included both active breaks between the lessons with a recall and/or transfer activities (review questions) and passive breaks within the lesson to allow learners to continue at their own pace after each slide/narration chunk. As discussed in chapter II, Clark and Mayer (2016) noted very little is known about how big a segment should be and how much information should be included in a segment. Therefore, the presented information and narration was chunked into small segments based on natural breaks in the material. Each segment ranged from approximately thirty seconds to one minute and fifteen seconds. At the end of the segment, a continue button appeared to allow the learners to process the information before continuing to the next segment. Segmenting and modality have both been studied individually and shown to improve learning (Ginns, 2005; Harskamp et al., 2007; Lee & Mayer, 2018; Low & Sweller, 2014; Mautone & Mayer, 2007; Mayer & Chandler, 2001; Mayer & Moreno, 1998; Mayer & Moreno, 1999; Mayer & Pilegard, 2014; Mayer et al., 2003; Mayer et al., 2018; Mayer et al., 2019; Moreno & Mayer, 2002; Moreno et al., 2001; O'Neil et al., 2000; Sung & Mayer, 2013); however, they have not been studied in combination and compared to the use of other combinations of principles and modality alone (M).

The PM treatment included both the pretraining and modality principles. Since modality was held constant in all four treatments, this treatment included visual elements and narration instead of visual elements and onscreen text. The use of pretraining presented terms and vocabulary at the beginning of the lesson rather than these items being integrated throughout. The pretraining sequencing provided an introductory unit that introduced the learners to a high-level overview that included vocabulary and important components of the process. Learners began with a unit that provided an overview of the foundational knowledge before moving on to the remaining portion of the lesson. There were two types of pretraining incorporated in this study: (1) facts, definitions, and low-level items and (2) why, how, goals, and a high-level overview. The researcher encouraged learners to take a break between the pretraining unit and the portion of the remaining lesson; however, this could not be enforced. The pretraining unit provided the learners with a continue button to advance at their own pace. Once the pretraining unit was completed, learners advanced (at their own pace) to the remaining instructional lesson. The lesson that followed the pretraining section auto advanced once the narration was finished on the presented slide. Pretraining and modality have been studied individually and shown to improve learning (Fiorella & Mayer, 2012; Gegner et al., 2009; Mautone & Mayer, 2007; Mayer & Chandler, 2001; Mayer et al., 2002; Mayer et al., 2003; Mayer et al., 2018; Mayer et al., 2019; Pilegard & Mayer, 2016; Pilegard & Mayer, 2018; Sung & Mayer, 2013); however, they have not been studied in combination and compared to different combinations of principles or modality only (M).

The PSM treatment included all elements from the other treatments: pretraining, segmenting, and modality. Modality was used since visual elements were shown with narration rather than onscreen text. The use of pretraining presented vocabulary and a high-level overview of the process upfront in the lesson. As previously described, learners began with a unit that overviewed the foundational knowledge before moving onto the remaining units. The use of segmenting included units that broke up (segmented) the instructional material. The presented information and narration were chunked into small segments based on natural breaks in the content, which ranged from approximately thirty seconds to one and a quarter minute. All units had a continue button that allowed learners to advance at their own pace which allowed them to take passive breaks within the lesson and active breaks between units. At the end of each unit, learners were provided with recall and/or transfer activities (review questions). Applying all three of the selected multimedia principles allowed the researcher to test if the three principles resulted in higher learning outcomes than applying pretraining and modality, segmenting and modality, or modality alone.

In summary, the sequencing and structure of the content was changed in each of the treatments. The same content and activities (review questions) were included in each treatment; however, the content was ordered, and activities were placed in different possible combinations to test if using different principles to sequence the content resulted in a higher overall, recall, and transfer posttest score.

The M treatment included all activities at the end of one continuous lesson. The PM treatment included activities at the end of the pretraining unit and remaining continuous lesson. The SM treatment included activities at the end of all active segmenting breaks (units). The PSM treatment included activities at the end of the pretraining unit and during active segmenting breaks (units). The information included within the entire lesson did not vary between treatment groups. Although the data from the recall and transfer activities (review questions) was not collected and analyzed, the activities gave learners the opportunity to practice recall and transfer prior to the scored posttest.

Instruments

A posttest was administered at the end of the instructional lesson. This 20-question summative test assessed how well learners could recall and transfer information from the multimedia instruction to other similar and different real-world tasks. The cognitive learning test focused on recall and transfer.

Learners were given scenarios to determine if a purchase involved nominal, limited, or extended decision making. Learners went through each step of a purchase and recalled and transferred knowledge from the module to the applicable scenario/situation. The cognitive learning test had learners define purchase involvement, differentiate between a low-involvement purchase and a high-involvement purchase, recognize nominal, limited, and extended decision making, and show the impact of purchase involvement on the decision process.

Validity was tested using content validity (Carmines & Zeller, 1979). Content validity (Carmines & Zeller, 1979) "depends on the extent to which an empirical measurement reflects a specific domain of content" (p. 20). Content validity was checked by having subject matter experts (SMEs) review the questions to ensure the content measured what it is intended to measure. In this study, the topic was types of consumer decision making. Three experts were asked to check the content and objectives to ensure the content matched the intended instructional outcomes and that no objectives were overemphasized or omitted.

In the context of multimedia learning, a recall question requires a learner to remember information by retrieving it from memory and recognizing it (Andrew & Bird, 1938). Recall has a learner remember something that was previously presented (Andrew & Bird, 1938; Day & Goldstone, 2012; Mariano, 2014); therefore, the 10 recall questions were designed to ask the learner to remember something from the lesson(s). Appendix B includes the test blueprint and Appendix C includes the recall questions included in the end of lesson activities and posttest.

According to Perkins and Salomon (1992) transfer "occurs when learning in one context or with one set of materials impacts performance in another context or with other related materials" (p. 3). In multimedia learning literature, knowledge transfer is represented by how well a learner can transfer basic cause and effect knowledge to similar problems or situations (Hummel et al., 2004; Mayer & Moreno, 1998); therefore, this representation was how the 10 transfer questions were created (see Appendix C for the transfer end of lesson activity and posttest questions).

Learners received a recall and/or transfer activity at the end of each lesson. The researcher reviewed articles on recall and transfer (further details are discussed in Chapter II) to identify and develop the recall and transfer activities (Andrew & Bird, 1938; Cooper & Sweller, 1987; Day & Goldstone, 2012; Dobson et al. 2018; Hajian, 2019; Halpern & Hakel, 2003; Hummel et al., 2003; Mariano, 2014; Mayer & Moreno, 1998; Perkins & Salomon, 1992).

Data Collection and Analysis

Moodle, the LMS used by the university where the study was conducted, was used to administer the treatments. Data for recall and transfer was collected using an anonymous cognitive learning posttest hosted in Qualtrics, also used by the university. At the end of the course, data was collected using the cognitive learning posttest. This test focused on how well learners could recall and transfer the content covered in the multimedia instruction to the similar and different consumer decision making tasks. All groups were given the same test and had the same amount of instructional and testing time.

University and FIN1115 demographics were used to describe the sample of the study for generalizability. Learners were asked at the end of the posttest to consent only if they agreed to participate and didn't meet any exclusion criteria. Any participants who were under 18, had a high level of prior knowledge on the topic, or who were retaking this course, were omitted from the study. This data was obtained from the university's Office of Institutional Research to describe the sample and generalizability of this study.

Inferential statistics were used to evaluate the research questions. This experimental design allowed the researcher to examine the effects of the independent variables (pretraining and segmenting) on a dependent variable (posttest score). Each independent variable had two levels (use and nonuse), as shown below in Table 3.

Table 3

Experimental Design

		Segmenting	
		Use	**Nonuse**
Pretraining	**Use**	Posttest score (PSM)	Posttest score (PM)
	Nonuse	Posttest score (SM)	Posttest score (M)

Note. The use of modality (M) was consistent for the four treatment groups. The modality only group (M) was used as the baseline group.

Therefore, a 2x2 factorial ANOVA allowed for multiple comparisons to be made. The main effects for segmenting, main effects for pretraining, and interaction effects of pretraining by segmenting were analyzed to answer the research questions listed at the beginning of this chapter.

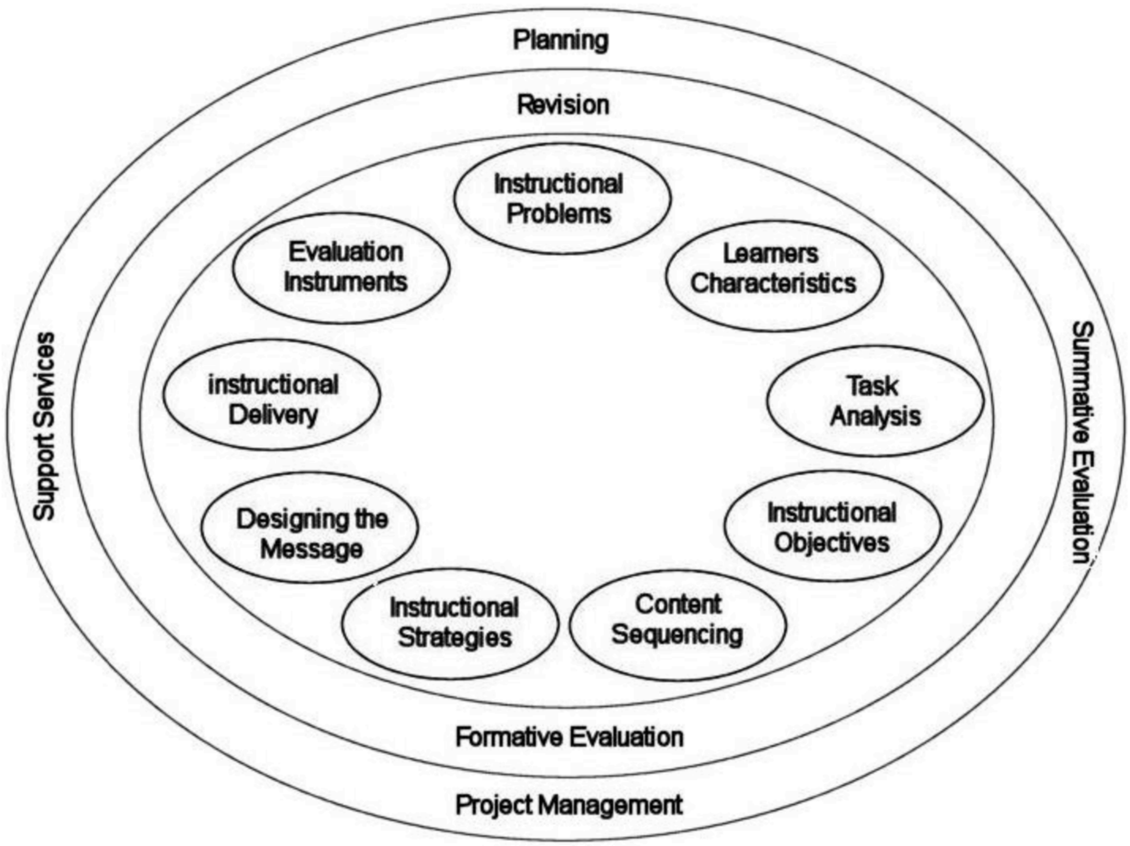
Instructional Design Model Used for the Development of the Treatment

The treatments were developed following the Kemp Model (Morrison et al., 2013). This model focuses on four main design elements important to consider during course development: learners, objectives, methods, and evaluation. These four basic components are broken down into nine main components (shown in the inner circles in Figure 5). Throughout the design of the project, there are also eight processes (shown in the outer circles of Figure 5).

The Kemp Model follows a similar process to other instructional design models, such as ADDIE, by including analysis, design, development, delivery, and evaluation phases (Morrison et al., 2013). The analysis phase includes the following components shown in Figure 5: instructional problems, learner characteristics, task analysis, and instructional objectives. The design phase includes the following components shown in Figure 5: content sequencing, instructional strategies, designing the message, and development of instruction. The evaluation phase includes the following component shown in Figure 5: evaluation instruments.

Figure 5

Components of the Kemp Model



Note. From "Designing Effective Instruction" by G. R. Morrison, S. M. Ross, H. K. Kalman, and J. E. Kemp, 2013, p. 12. Copyright 2013 by John Wiley & Sons, Inc. The permission to provide a copy of this figure is shown in Appendix A: Permissions.

Instructional Problems

Consumer behavior is defined as "the study of individuals, groups, or organizations and the processes they use to select, secure, use, and dispose of products, services, experiences, or ideas to satisfy needs and the impacts that these processes have on the consumer and society" (Mothersbaugh & Hawkins, 2016, p. 6). According to these authors, consumer behavior has become integrated and applied in marketing strategy, regulatory policy, and social marketing. Consumer behavior can be used to inform individuals (Mothersbaugh & Hawkins, 2016). An upper-division Consumer Behavior course is required for all marketing majors at the university where this study was conducted. The purpose of the introductory finance course is to introduce learners to personal finance. Marketing is a central field in business; therefore, an overview of marketing and the consumer decision making process fits within the scope of and learners needs in the introductory finance course. Consumer decision making can be a valuable asset in finance. More details on the learner's needs are found in Appendix D.

Learner Characteristics

Fall 2022 university and FIN1115 demographics were used to describe learner characteristics. Data from the Office of Institutional Research was used to describe the sample. Most learners enrolled in this course were expected to be freshmen or sophomores, with little to no prior business knowledge or experience. Demographics are described in further detail in Chapter IV.

During the design and development of the instructional materials, novice learners were one of the main considerations. Consumer Behavior is a required upper division course for marketing majors. The introductory finance course gave novice learners an idea of introductory business concepts. Some of the learners will major in marketing, while other learners plan on majoring in another business area, such as finance, management, or accounting. Some learners may not choose to major in business. The topic can benefit learners, regardless of their major, both personally and professionally. This information is useful when considering items, they, or a company they are part of, are going to purchase. Some learners could have perceived the applicability of the course differently than others. Some learners may have been nonbusiness majors exploring a minor or other option in business. This introductory course has the opportunity to influence learners' decisions about their major by introducing them to new concepts and topics.

Another factor the instructional designer considered was the level of difficulty of the instruction. Morrison et al., (2013) suggests designing the level of difficulty to be slightly higher than ideal for the typical learner. The instruction should be challenging but not too hard for the learner. The instructional content was designed to a level of difficulty that was challenging but not too hard for a novice learner.

Learners were required to have access to a computer with internet. This course was not able to be completed on a cell phone. Learners needed to know how to access the course in Moodle and navigate through the course. On screen instructions were provided to help learners navigate through the course and review questions. Most learners used their personal computers to access the instructional content. Some learners may have gone to a computer lab on campus to access the material. Only one attempt was allowed. The course had to be completed in one setting and learners could not return later.

The designer considered environmental factors that may have influenced the learners. Learners were not in a controlled environment, so the researcher considered several factors that may have influenced the learning environment. Factors such as lighting, noise, temperature, seating, accommodations, and equipment were uncontrolled for this lesson. Learners were given two weeks and asked for a block of undisturbed time during this timeframe to complete the treatment, although some environmental factors may have been present. Outside distractions, such as noise (tv, children, loud cars/trucks, music, etc.), poor internet connection, temperature, open windows on the computer, email notifications, cell phones, etc. may have influenced the learning environment. Each learner's environment was different depending on where they were when they were accessing the course. There was no control over if the learners took notes or not, if they had an open tab or textbook with material, if they did the assignment together, etc. Most of these uncontrolled factors are real in most learning environments outside of a controlled laboratory setting.

Regardless of the treatment group, learners were presented with the same review questions. These review questions were either at the end of the continuous lesson or at the end of each unit, depending on the treatment group. This design allowed learners to apply the knowledge and skills learned during the instructional lesson (Morrison, et al., 2013). These review questions were intended to help learners recall and transfer the presented information to similar and new situations.

Task Analysis

The researcher assumed the role of both the instructional designer and subject matter expert (SME) to design and develop the instructional materials. The instructional designer conducted a task and topic analysis to identify key facts, concepts, definitions, and tasks learners would need to know or do following the instruction (see Appendix D for details). The book *Consumer Behavior: Building Marketing Strategy* (Mothersbaugh & Hawkins, 2016, p. 4-30, 496-513) was referenced to ensure content accuracy.

Instructional Objectives

There were two types of instructional objectives created for this lesson: terminal and enabling (Gallagher & Smith, 1989). According to Gallagher and Smith, the terminal objectives are the overall course goals. These objectives should state what the student will do as well as how achievement of the objective will be demonstrated (Gallagher & Smith, 1989). In this study, at the end of the treatment, learners should have been able to:

1. Define purchase involvement.
2. Differentiate between a low-involvement purchase and a high-involvement purchase.
3. Classify nominal, limited, and extended decision making.
4. Show the impact of purchase involvement on the decision process.
5. Follow the consumer decision making process.

These objectives aligned with the topic/task analysis conducted and were assessed with the posttest. These terminal objectives were given further elaboration and considered in greater detail (Gallagher & Smith, 1989). Enabling objectives provide this detail.

Enabling objectives support learners achieving specific prerequisites in order to fulfill the terminal objectives (Gallagher & Smith, 1989). These enabling objectives are essential components to the broader, terminal objectives. The enabling objectives were created for each treatment and each topic within the treatment to fulfill the terminal objectives of the course. See Appendix E for the detailed enabling objectives for each treatment group.

Content Sequencing

The process of consumer decision making follows a linear and specific process (Mothersbaugh & Hawkins, 2016). The instructional content was designed to follow the process and flow of events as they happen in real life. The lesson was presented in a way that allowed learners to only advance forwards and backwards in the lesson. Learners were not allowed to skip around and choose their path forward. The sequencing of the content is shown in Appendix F. As previously noted, there were four treatment groups in this study. The sequencing of the content slightly differed depending on the treatment group; however, the overall consumer decision making process was followed linearly throughout all four treatments. All four treatments received the same information. More details on the differences between the four groups were provided in a previous section in this chapter.

Instructional Strategies

Once the tasks and topics were identified, objectives had been created, and the sequence of the content was determined, the instructional designer considered the instructional strategies that were used. The instructional strategies included the pretraining, segmenting, and modality multimedia principles included in the four treatments: M, SM, PM, and PSM. These instructional strategies have been discussed in further detail above in the treatments section and in chapter II.

Design

After completion of the analysis phase, the objectives were used to create a rough outline of the content for each treatment group (see Appendix G for more details). Once the outline was created, a storyboard was created in PowerPoint and a script for the accompanying narration was created. A draft of activities for end of unit/lesson practice questions was also created.

Visual design elements were considered during the design of the instructional materials. Lists, headings, signals, comparisons, definitions, and examples were included to illustrate the consumer decision making process. The layout was designed to be clean; cues such as bold, underline, and italics were considered sparingly and only used to draw emphasis; and headings, titles, and key words/phrases were used. Pictures and graphics were used to illustrate the process, represent the steps of the process, and organize the content to use both visual and auditory channels of the brain. Extraneous, or unnecessary, graphics were not included or used. Most graphics in the instructional material were created using PowerPoint shapes and features. Some images were found from copyright free photo websites, such as pixabay.com & pixlr.com.

Development of Instruction

The narration was recorded and edited using Audacity. The instructional materials were created in PowerPoint (see Appendix H for detailed slides and corresponding narration) and then imported into Articulate Storyline 360. Storyline 360 provided control over pacing and the option for learner control. This authoring tool provided the functionality needed to lock down the content, so it could only be viewed in a linear fashion that followed the consumer decision making process. It also allowed the researcher to control different elements in each of the four treatments, such as auto advance versus passive segmenting breaks, placement of review questions, and feedback for correct or incorrect review question responses.

The narration recordings were imported to the corresponding slides and aligned with the slide content using the timeline, triggers, and variable functionality. Storyline 360 allowed the option to include the review questions in one single file with the course. Once the instructional materials were fully developed, the files were exported as a SCORM 1.2 packages and uploaded to Moodle. Learners were randomly assigned to one of four treatment groups and only had access to their assigned treatment. The posttest was created using Qualtrics and included the recall and transfer questions previously discussed. Qualtrics provided learners with complete anonymity for their posttest scores. The Storyline slides are shown in Appendix I.

Evaluation Instruments

Recall and transfer review questions were provided at the end of the segments (pretraining or segmenting) or at the end of the continuous lesson (no pretraining or segmenting). Ungraded review questions were provided at the end of the units or lesson that provided learners with practice opportunities to build schemata prior to the posttest. Multiple-choice, select all that apply, and categorization questions were used to determine if learners met the stated objectives (previously described and shown in Appendix E). All learners received the same review and posttest questions. The review and posttest questions are shown in Appendix C. In summary, each of the components of the Kemp Model: instructional problems, learner characteristics, task analysis, instructional objectives, content sequencing, instructional strategies, design, development of instruction, and evaluation instruments were considered and described in the previous paragraphs.

Summary

This chapter has outlined the methods that were used in this research study, as well as the instructional design process that was followed to design and develop the instructional content. This study tested if learners recalled and transferred a new concept more effectively by managing intrinsic load using different combinations of CTML principles: pretraining and segmenting with modality (PSM), pretraining with modality (PM), segmenting with modality (SM), versus modality alone (M).

CHAPTER IV

Results

The purpose of this experimental study was to test if using three CTML principles (segmenting, pretraining, and modality), two pairs of principles (pretraining and modality or segmenting and modality), or a single principle (modality) better managed intrinsic load for learners learning a new concept. This study compared results of recall, transfer, and overall scores between four treatment groups: PSM, SM, PM, and M. The data collected were analyzed to answer the following research questions:

1. Do any of the four combinations of the use/non-use of the pretraining and segmenting principles, combined with modality, cause an increase in college learners' overall scores for an online test of consumer decision-making knowledge?

   Research hypotheses for question 1 ($\alpha = 0.05$):

   H_0: There is no significant difference in overall posttest scores between the PSM, PM, SM, and M groups.

   H_1: There is at least one significant difference in overall posttest scores between the PSM, PM, SM, and M groups.

2. Do any of the four combinations of the use/non-use of the pretraining and segmenting principles, combined with modality, cause an increase in college learners' recall scores for an online test of recall of consumer decision-making knowledge?

   Research hypotheses for question 2 ($\alpha = 0.05$):

   H_0: There is no significant difference in posttest recall scores between the PSM, PM, SM, and M groups.

H_1: There is at least one significant difference in posttest recall scores between the PSM, PM, SM, and M groups.

3. Do any of the four combinations of the use/non-use of the pretraining and segmenting principles, combined with modality, cause an increase in college learners' transfer scores for an online test of transfer of consumer decision-making knowledge?

   Research hypotheses for question 3 ($\alpha = 0.05$):

   H_0: There is no significant difference in posttest transfer scores between the PSM, PM, SM, and M groups.

   H_1: There is at least one significant difference in posttest transfer scores between the PSM, PM, SM, and M groups.

Description of the Sample

University and FIN1115 demographics for undergraduate students enrolled in the Fall 2022 semester were used to describe the sample. For the selected sample enrolled in FIN 1115, 51% of the enrolled students were female and 49% were male. Fifty nine percent of undergraduate students were enrolled full-time and 41% were enrolled part-time. 21% of undergraduate students were first generation students and 21% also reported they were nontraditional students. Undergraduate enrollment for FIN 1115 by race/ethnicity is shown in Table 4 below, enrollment by age category is shown in Table 5 below, and enrollment by student classification is shown in Table 6 below. The following paragraphs describe the university students sampled for this study.

Table 4

Undergraduate Enrollment for FIN 1115 by Race/Ethnicity

Race/Ethnicity	% of Total
American Indian/Alaskan Native	1
Asian	0
Black/African American	2
Hispanic/Latino	13
Non-Resident Alien	4
Two or More Races	3
Unknown	5
White/Non-Hispanic	72

Table 5

Undergraduate Enrollment for FIN 1115 by Age Category

Age Category	% of Total
Under 18	34
18 to 24	60
25 to 30	3
31 to 40	2
41 to 50	1
51+	0

Table 6

Undergraduate Enrollment for FIN 1115 by Student Classification

Classification Level	% of Total
Freshman (0-25 credits)	68
Sophomore (26-57 credits)	20
Junior (58-89 credits)	8
Senior (90+ credits)	4
Post Baccalaureate	1

Note. Post Baccalaureate student classification are students that have earned a bachelor's degree and are pursuing another undergraduate degree.

The sample consisted of university students (mostly freshmen and sophomores) enrolled in an introductory finance course at a medium size university in the intermountain west during the fall 2022 semester. The percentage of students under the age of 18 was high due to dual enrollment courses offered both across and off campus. There was a dual enrollment section of FIN 1115 taught at local high schools. One of the exclusion criteria identified in Chapter III was being under the age of 18. Because of the exclusion criteria identified in Chapter III, the dual enrollment section was not included in the sample for this study.

Two face-to-face and one online sections of the introductory finance course participated in the study with a total potential sample of 217 learners. One hundred forty-nine of those learners completed the treatment posttest. Learners who did not consent to their data being used were removed from the study. If learners only completed one set of questions, either recall or transfer, they were removed from the study. Since both recall and transfer were assessed, the researcher felt it would be unrepresentative to include only one type of data, either recall or transfer.

Of the 149 learners that completed the treatment posttest, 133 learners completed the posttest, consented to their data being used, did not meet exclusion criteria, and were not considered outliers using the Tukey's hinges method (Schwertman, et al., 2004). The following section discusses the descriptive statistics of this sample.

Descriptive Statistics

As mentioned above, 133 learners completed all portions of the posttest and were not considered outliers. There was a total of 43 learners in the M group, 43 learners in the PM group, 36 learners in the SM group, and 27 learners in the PSM group. Table 7 below shows the descriptive statistics for each group for overall, recall, and transfer posttest scores. The posttest had a total of 20 questions, 10 recall questions and 10 transfer questions, worth one point for each correct response (more details are shown in Appendix B: Test Blueprint). The recall portion of the exam had 14 total possible points and the transfer portion had 29 possible points, for a total of 43 points possible. The data in Table 7 below shows posttest scores as percentages rather than raw points for overall, recall, and transfer scores.

Table 7

Descriptive Statistics for Posttest Scores (%), by Group and Question Type

	N	Mean	SD	Min	Max
Overall (20 questions)					
M Group	38	75.95	8.10	60.47	90.70
PM Group	38	78.76	9.23	58.14	97.67
SM Group	30	78.76	7.65	55.81	90.70
PSM Group	27	75.45	8.78	53.49	90.70
Total	133	77.23	8.44	53.49	97.67
Recall (10 questions)					
M Group	38	80.83	14.49	50.00	100
PM Group	38	82.14	11.60	57.14	100
SM Group	30	80.71	11.28	57.14	100
PSM Group	27	77.51	11.15	57.14	100
Total	133	80.3	12.13	50.00	100
Transfer (10 questions)					
M Group	38	73.59	7.91	55.17	89.66
PM Group	38	77.13	11.09	51.72	100
SM Group	30	77.82	8.76	55.17	93.10
PSM Group	27	74.46	10.31	51.72	93.10
Total	133	75.75	9.52	51.72	100

The descriptive statistics show a similar pattern for overall and transfer scores. This pattern shows two of the three principles (either PM or SM) resulted in the highest overall, recall, and transfer scores compared to modality alone or all three principles (PSM). The following paragraphs will further describe this pattern.

The pattern shows the PM group scored higher than the M group in overall, transfer, and recall scores. When compared to the M group, the PM group had a mean score that was 2.81% higher for overall scores, 1.31% higher for recall scores, and 3.54% higher for transfer scores. This pattern revealed that learners who received the lesson with pretraining and modality scored better on the posttest than learners who received the lesson with modality only.

The PM group also scored higher than the PSM group in overall, transfer, and recall scores. The PM group had a mean score of 4.09% higher than the PSM group for overall scores, 6.37% higher for recall scores, and 2.99% higher for transfer scores. This pattern revealed learners who received the lesson with pretraining and modality scored better on the posttest than learners who received the lesson with pretraining, segmenting, and modality. The pattern in the descriptive statistics show the PM group scored higher than the M and PSM groups for recall, transfer, and overall scores. This pattern will be further analyzed in the following sections.

The SM group scored higher than M in transfer and overall scores, but not recall. When compared to the M group, the SM group had a mean score that was 2.81% higher for overall scores and 4.23% higher for transfer scores. The M group had a small advantage of 0.12% over the SM group for recall. This pattern revealed that learners who received the lesson with segmenting and modality scored better than learners who received the lesson with modality alone on the transfer and overall posttest. Learners who received the lesson with modality alone scored slightly higher on recall than the learners who received the lesson with segmenting and modality.

The SM group also scored higher than the PSM group in overall, transfer, and recall scores. The SM group had a mean score 4.09% higher than the PSM group for overall scores, 4.94% higher for recall scores, and 3.68% higher for transfer scores. This pattern revealed that learners who received the lesson with segmenting and modality scored better on the posttest than learners who received the lesson with pretraining, segmenting, and modality. The pattern in the descriptive statistics show the SM group scored higher than the M and PSM groups for transfer and overall scores. This pattern will be further analyzed in the following sections.

When comparing the PM and SM groups, the descriptive statistics show these two groups were nearly equal in mean overall, recall, and transfer posttest scores. These two groups had the same mean score for overall test scores. The biggest difference between the groups was for recall scores, with the PM group scores being 1.43% higher than the SM group scores. The PM and SM scores were close for transfer scores, with the SM group's mean transfer score being 0.69% higher than the PM group.

These patterns will be further tested in the following sections. These sections discuss further analyses performed to compare the four treatment groups to see if there were any statistical differences between the mean overall, recall, and posttest scores. These analyses were performed using SPSS and answered the research questions discussed at the beginning of this chapter. The following sections will discuss findings to address each of these research questions.

Results for Research Question 1

The first research question asked if any of the four combinations of the use/non-use of the pretraining and segmenting principles, combined with modality, caused an increase in overall scores for an online test of consumer decision-making knowledge. To determine if there was a statistically significant difference in overall scores between the PSM, PM, SM, and M groups, a

2x2 MANOVA with planned contrasts was calculated on overall posttest scores. All groups were assumed to be statistically equivalent because no violation of homogeneity of variance was found. A MANOVA was used because the research questions compared the same subjects using recall and transfer scores as additional dependent variables to overall scores.

The results of the MANOVA showed no statistically significant main effect for overall posttest scores for pretraining [F (1, 129) = .025, p = .874]. These results showed the group with subjects who received pretraining with modality, on average, scored no differently from the subjects who received modality with no pretraining.

The results also showed no statistically significant main effect for overall scores for segmenting [F (1, 129) = .035, p = .851]. These results showed the group with all subjects who received segmenting with modality, on average, scored no differently from the subjects who received modality with no segmenting.

However, results showed there was a statistically significant interaction effect for overall scores [F (1, 129) = 4.383, p = .038]. These results for the main and interaction effects are shown in Table 8 below.

Table 8

ANOVA: Effects for Overall Scores

Source	**Dependent Variable**	**df**	**F**	**η^2**	**p**
Pretraining	OverallScore	1	.025	.000	.874
Segmenting	OverallScore	1	.035	.000	.851
Pretraining* Segmenting	OverallScore	1	4.383	.033	.038*

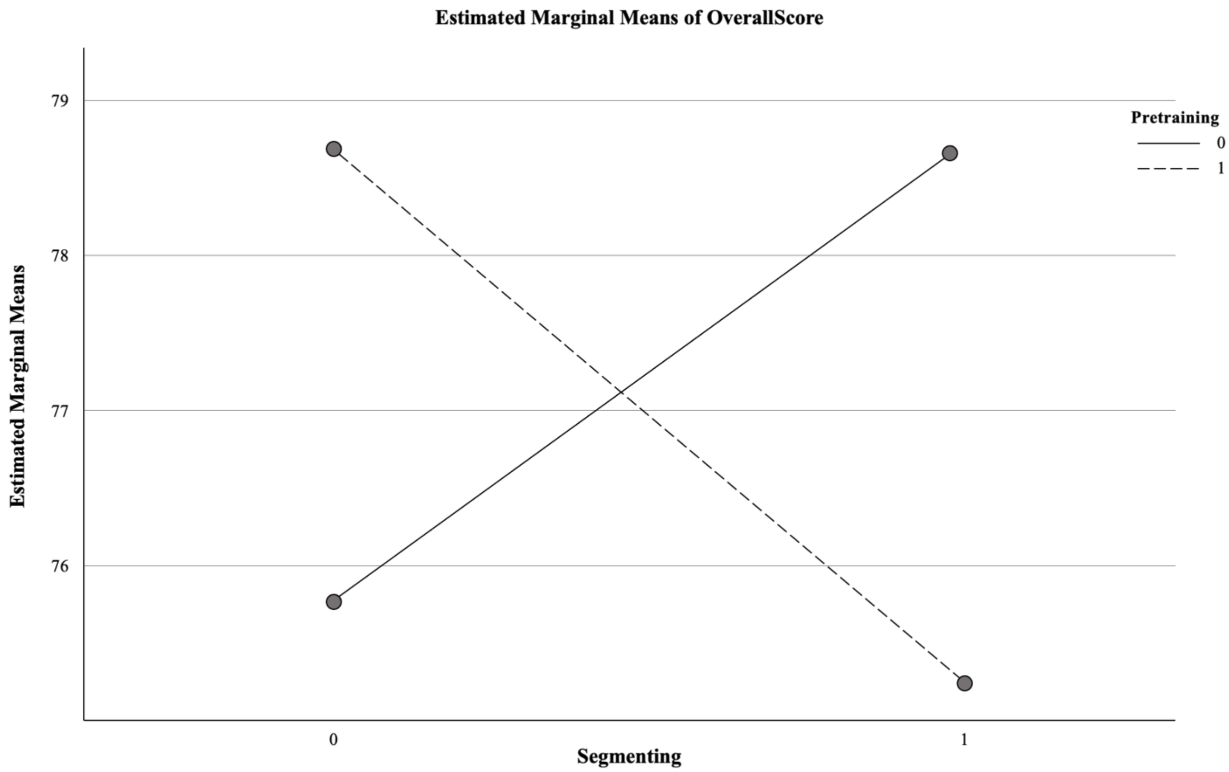
Note. An * indicates statistical significance at the $\alpha = 0.05$ level.

These interaction results implied at least one group scored statistically significantly different when compared to the other groups. The most direct interpretation of these results showed the differences between the PM and SM groups in overall scores were due to random chance; however, another group (M or PSM) could have been significantly higher or lower.

The statistically significant interaction effect [$F(1, 129) = 4.383$, $p = .038$] showed adding either pretraining or segmenting had a different effect on scores based upon what treatment(s) the principles were added to. When either principle was added to modality alone, scores generally went up; however, when either principle was added to modality and the other principle, the scores tended to go down. These findings are shown in Figure 6 below. The interaction effect between pretraining and segmenting suggested combining the three principles to manage intrinsic load (lower right dot in Figure 6 below) or using modality alone (lower left dot in Figure 6 below), led to lower overall scores than applying either pretraining or segmenting with modality (upper dots in Figure 6 below).

Figure 6

Interaction Effect for Overall Scores



Note. A different interaction of the variables cause segmenting to not have a consistent effect. This diagram shows segmenting combined with modality without pretraining was generally better for overall learning than pretraining, segmenting, and modality. Since the averages for segmenting and modality, and no segmenting with modality, were close, there was no statistical significance, meaning there was no significant differences between test scores.

To complement the MANOVA and further investigate the statistically significant interaction effect, planned contrasts were conducted to further compare each group. According to Rosenthal and Rosnow (1985), “contrasts are significance tests of focused questions in which specific predictions can be evaluated by comparing these predictions to the obtained data” (p. 1). These authors note using contrast analysis allows the researcher to ask focused questions about the data. The pattern of the contrasts was based on the pattern of data the researcher expected to see based on the MANOVA results. The p-value in the contrast table output is the same as the F value in the ANOVA table output. Because of this, the MANOVA and contrasts are the same analysis; however, because the contrast analysis provided a p-value, a one-tailed test was conducted by cutting the p-value from the contrast analysis in half (Furr & Rosenthal, 2003; Rosenthal & Rosnow, 1985).

Performing a contrast analysis provided a relatively clear and direct evaluation of the research questions (Furr & Rosenthal, 2003); therefore, planned contrasts were performed to compare the means of the different groups to one another for overall, recall, and transfer scores. The pattern of contrasts, shown in Table 9 below, was based on the pattern of data the researcher expected to see based on the patterns in the data described above.

Table 9

Contrast Coefficients

Contrast	**Group**			
	1(M)	**2(PM)**	**3(SM)**	**4(PSM)**
1	-1	1	0	0
2	-1	0	1	0
3	-1	0	0	1
4	0	1	-1	0
5	0	1	0	-1
6	0	0	1	-1
7	-1	1	1	-1
8	-2	1	1	0
9	0	1	1	-2

Contrasts seven, eight, and nine were statistically significantly different for overall scores. The result for contrast seven showed the combination of the groups who received pretraining and modality (PM) or segmenting and modality (SM) scored statistically significantly higher than the combination of the modality alone (M) and pretraining, segmenting, and modality (PSM) groups. Contrast eight showed learners who received two principles (either PM or SM) in their treatment did better overall than learners who received modality alone. Contrast nine showed that learners who received two principles in their treatment did better overall than learners who received three principles (PSM). The results of the contrast analyses are shown in Table 10 below.

Table 10

Contrast Tests for Overall Score (Assumes Equal Variances)

Contrast	**Value of Contrast**	**Std. Error**	**T**	**p (1-tailed)**
1 (1 – 2)	2.89	1.958	1.479	.071
2 (1 – 3)	2.85	2.084	1.368	.087
3 (1 – 4)	-.52	2.148	-.242	.405
4 (2 – 3)	.04	2.084	.021	.492
5 (2 – 4)	3.41	2.148	1.590	.057
6 (3 – 4)	3.37	2.263	1.489	.070
7 (1& 4, 2&3)	6.27	2.993	2.094	.019*
8 (1 – 2&3)	5.75	3.465	1.658	.05*
9 (4 – 2&3)	6.78	3.890	1.744	.042*

Note. An * indicates statistical significance at the $\alpha = 0.05$ level.

The statistically significant interaction effect showed although no other groups were found to have statistically significant differences in the contrast analysis, there was an increase in overall scores with the two groups who received either pretraining and modality or segmenting and modality compared to the groups who received pretraining, segmenting, and modality, or modality alone.

As mentioned above, the results for contrast seven were statistically significant. Contrast seven compared the combination of the M and PSM groups' overall scores to the combination of the PM and SM groups' overall scores. These findings indicate the overall scores of the PM and SM groups combined were statistically significantly higher than the M and PSM groups combined [T (129) = 2.094, p = .019]. Implications of these findings will be discussed in Chapter V.

The results for contrast eight were also statistically significant. Contrast eight compared the M group's overall scores to the PM and SM groups' scores combined. These findings imply that the use of two principles (either pretraining and modality or segmenting and modality) was better than using modality alone for overall scores [T(129) = 1.658, p = .05].

The results for contrast nine were statistically significant. Contrast nine compared the PSM group's overall scores to the PM and SM groups' scores combined. These findings imply that the use of two principles (either pretraining and modality or segmenting and modality) was better than the use of three principles (pretraining, segmenting, and modality) for overall scores [T(129) = 1.994, p = .027]. Based on the findings of the described contrasts, these treatments interacted in such a way that pretraining and modality or segmenting and modality were more likely to raise overall scores than pretraining, segmenting and modality, or modality alone.

Although there were no statistically significant differences found for the other contrasts, some p-values approached statistical significance (contrast one, p = .071; contrast two, p = .087; contrast five, p = .057; contrast six, p = .070), when $\alpha = 0.05$. This is how these results will be interpreted; however, they will appear again in Chapter V for future recommendations.

Because of the small effect sizes found in the MANOVA and probabilities nearing statistical significance for some contrasts, a power analysis was done for the main MANOVA. These findings are shown in Table 11 below. This observed power showed there was a little higher than a 50% chance to see a statistically significant effect with the sample size in this study. This will be further addressed in the future research recommendations in Chapter V.

Table 11

Test of Between-Subject Effects

Source	Dependent Variable	p	Observed Power[d]
Pretraining	RecallScore	.666	.071
	TransferScore	.961	.050
	OverallScore	.874	.053
Segmenting	RecallScore	.278	.191
	TransferScore	.645	.074
	OverallScore	.851	.054
Pretraining * Segmenting	RecallScore	.303	.176
	TransferScore	.048*	.509
	OverallScore	.038*	.547

Note. An * indicates statistical significance at the $\alpha = 0.05$ level.

Overall, there were no main effects found for pretraining or segmenting for overall posttest scores. These results showed the group with all subjects who received segmenting with modality, or pretraining with modality, on average, scored no differently from the subjects who received modality with no segmenting or modality with no pretraining. Additionally, results showed there was a statistically significant interaction effect for overall scores. This interaction effect indicated adding a principle to the instruction had a different effect based on the other principles already included in the instruction. The combination of principles had different effects on overall scores based upon what other principles (variables) were already in the treatment. There was no consistent effect across all cases when pretraining or segmenting was added. If they were both individually added to modality alone, learners scored higher overall.

To further analyze these results, a contrast analysis was performed to compare each group. Results of the contrasts for overall posttest scores showed statistically significant results for the combination of the PM and SM groups scoring higher on overall scores compared to the combination of the M and PSM groups. Results for the contrasts also showed statistically significant results for the combination of the PM and SM groups scoring higher on overall scores compared to the M group. Furthermore, results for the contrasts showed statistically significant results for the combination of the PM and SM groups scoring higher on overall scores compared to the PSM group. Implications of these findings will be further discussed in Chapter V.

Results for Research Question 2

The second research question asked if any of the four combinations of the use/non-use of the pretraining and segmenting principles, combined with modality, caused an increase in recall scores for an online test of consumer decision-making knowledge. All groups were assumed to be statistically equivalent because no violation of homogeneity of variance was found. To determine if there was a statistically significant difference in posttest recall scores between the PSM, PM, SM, and M groups, a two-way MANOVA was conducted. The results of the MANOVA showed no main effect for recall posttest scores for pretraining [$F\ (1, 129) = .187$, $p = .666$]. These results showed the group with subjects who received pretraining with modality, on average, scored no differently on recall questions from the subjects who received modality with no pretraining.

The results also showed no main effect for recall scores for segmenting [$F\ (1, 129) = 1.185$, $p = .278$] combined with modality. These results revealed the group with all subjects who received segmenting with modality, on average, scored no differently on recall questions from the subjects who received modality with no segmenting.

Furthermore, results showed there was no interaction effect for recall scores [$F\ (1, 129) = 1.068$, $p = .303$]. These results are shown in Table 12 below.

Table 12

ANOVA: Effects for Recall Scores

Source	Dependent Variable	df	F	ηp^2	Sig.
Pretraining	RecallScore	1	.187	.001	.666
Segmenting	RecallScore	1	1.185	.009	.278
Pretraining* Segmenting	RecallScore	1	1.068	.008	.303

There were no statistically significant findings for recall as there were no main or interaction effects. The most direct interpretation of these results showed the differences between the groups in recall posttest scores were due to random chance and no group scored statistically significantly differently than any of the other groups. Implications of these results will be addressed in Chapter V.

Results for Research Question 3

The third research question asked if any of the four combinations of the use/non-use of the pretraining and segmenting principles, in concert with modality, caused an increase in transfer scores for an online test of consumer decision-making knowledge. All groups were assumed to be statistically equivalent because no violation of homogeneity of variance was found. To determine if there was a statistically significant difference in transfer scores between the PSM, PM, SM, and M groups, a two-way MANOVA with planned contrasts was calculated on transfer posttest scores.

The results of the MANOVA showed no main effect for transfer posttest scores for pretraining [$F(1, 129) = .002$, $p = .961$]. These results showed the group with subjects who received pretraining with modality, on average, scored no differently for transfer from the subjects who received modality with no pretraining.

The results also showed no main effect for transfer scores for segmenting [F (1, 129) = .213, p = .645] combined with modality. These results revealed the group with all subjects who received segmenting with modality, on average, scored no differently on transfer from the subjects who received modality with no segmenting.

Furthermore, results showed there was an interaction effect for transfer scores [F (1, 129) = 3.984, p = .048]. These results implied at least one group was statistically significantly different from at least one other group. The results described above are shown in Table 13 below.

Table 13

ANOVA: Effects for Transfer Scores

Source	**Dependent Variable**	**df**	**F**	**η^2**	**p**
Pretraining	TransferScore	1	.002	.000	.961
Segmenting	TransferScore	1	.213	.002	.645
Pretraining* Segmenting	TransferScore	1	3.984	.030	.048*

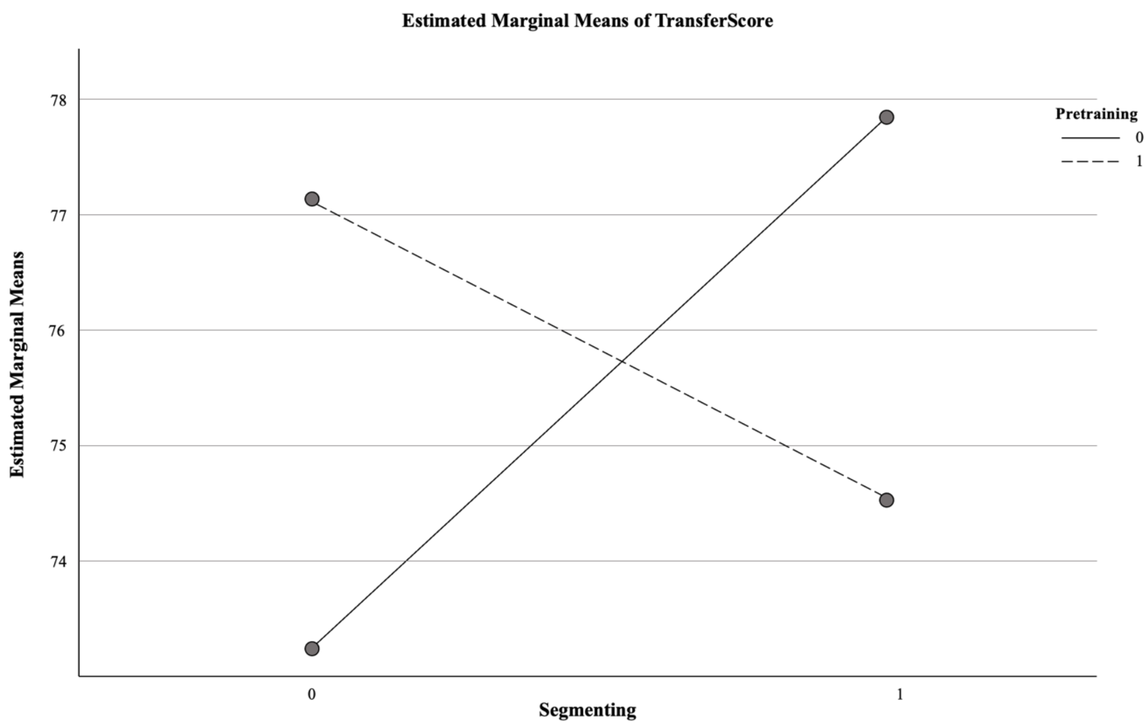
Note. An * indicates statistical significance at the $\alpha= 0.05$ level.

The significant interaction effect [F (1, 129) = 3.984, p = .048] for transfer scores showed adding either pretraining with modality or segmenting with modality seemed to be more optimal for learning. This interaction effect indicated adding a principle to the instruction had a different effect based on the other principles previously included in the instruction. The combination of principles had different effects on overall scores based upon what other principles were already in the instruction. There was no consistent effect across all cases when pretraining or segmenting was added. If either pretraining or segmenting individually were added to modality alone, learners scored higher overall.

When either pretraining or segmenting was added to modality alone, scores generally went up; however, when either principle was added to modality and the other principle, the scores tended to go down. These findings are shown in Figure 7 below. The interaction effect between pretraining and segmenting suggested combing the three principles to manage intrinsic load (lower right dot in Figure 7 below) or using modality alone (lower left dot in Figure 7 below), led to lower overall scores than applying either pretraining or segmenting with modality (upper dots in Figure 7 below).

Figure 7

Interaction Effect for Transfer Scores



Note. A different interaction of the variables cause segmenting to not have a consistent effect. This diagram shows segmenting combined with modality without pretraining was generally better for transfer than pretraining, segmenting, and modality. Since the averages for segmenting and modality, and no segmenting with modality, were close, there was no statistical significance, meaning there was no significant differences between test scores.

To complement the MANOVA, planned contrasts, the same as discussed above for research question one, were conducted to compare each group. Once again, the researcher was able to perform a one-tailed test using contrast analysis (Furr & Rosenthal, 2003; Rosenthal & Rosnow, 1985). Contrasts two, seven, and eight were statistically significantly different for transfer scores. The contrast two results showed segmenting and modality (SM) was better than modality alone (M) for increasing transfer scores. The result for contrast seven showed the combination of the groups who received pretraining and modality (PM) and segmenting and modality (SM) scored statistically significantly higher than the combination of the modality alone (M) and pretraining, segmenting, and modality (PSM) groups. Contrast eight showed learners who received a treatment with two principles (PM or SM) did better for transfer than learners who received modality alone (M). These findings are shown in Table 14 below.

Table 14

Contrast Tests for Transfer Score (Assumes Equal Variances)

Contrast	**Value of Contrast**	**Std. Error**	**T**	**p (1-tailed)**
1 (1 – 2)	3.45	2.205	1.563	.060
2 (1 – 3)	4.14	2.347	1.764	.040*
3 (1 – 4)	.56	2.419	.356	.362
4 (2 – 3)	-.69	2.347	-.296	.384
5 (2 – 4)	2.89	2.419	1.069	.144
6 (3 – 4)	3.59	2.550	1.287	.100
7 (1& 4, 2&3)	6.73	3.371	1.996	.024*
8 (1 – 2&3)	7.59	3.903	1.944	.027*
9 (4 – 2&3)	5.87	4.381	1.339	.092

Note. An * indicates statistical significance at the $\alpha = 0.05$ level.

The results for contrast two were statistically significant. Contrast two compared the M group's transfer scores to the SM group's transfer scores. The results from this analysis imply that the use of segmenting and modality was more likely to raise transfer scores than the use of modality alone [T (129) = 1.764, p = .040].

The results for contrast seven were also statistically significant. Contrast seven compared the combination of the M and PSM groups' scores to the combination of the PM and SM groups' scores. These findings indicate the transfer scores of the PM and SM groups combined were statistically significantly higher than the M and PSM groups combined [T (129) = 1.996, p = .024].

Contrast eight, which was also statistically significant, compared the M group's transfer scores to the PM and SM groups' scores combined. These findings imply that the use of two principles (either pretraining and modality or segmenting and modality) was better than using only one principle (modality alone) for transfer scores [T(129) = 1.994, p = .027]. No other combination of multimedia principles scored any differently than M alone for transfer. Although there were no statistically significant differences found for the other contrasts, the p-value of contrast one approached statistical significance [T (129) = .356, p = .060], when $\alpha = 0.05$.

These findings provide recommendations to instructional designers for using segmenting and modality, or pretraining and modality. Either of these combinations (pretraining and modality or segmenting and modality) may be better than pretraining, segmenting, and modality or modality alone. The findings also showed segmenting and modality resulted in higher transfer scores than modality alone. The implications of these findings will be discussed further in Chapter V. The following section summarizes the findings from this study before discussing implications.

Summary of the Results

This experimental study analyzed the main and interaction effects of different combinations of modality, pretraining, and segmenting to determine if there was a statistical significance between four groups (M, PM, SM, and PSM) on overall, recall, and transfer posttest scores. This experiment was conducted using a short web-based lesson on consumer decision making types in an introductory finance course at a medium-sized university in the intermountain west. With an alpha level of 0.05, there were no main effects for pretraining or segmenting for overall, recall, or transfer posttest scores.

With an alpha level of 0.05, there was an interaction effect for overall scores and an interaction effect for transfer scores. No interaction effect was found for recall scores. After the 2x2 MANOVA was performed, a planned contrast analysis was conducted to compare the means of each group. Results of the contrasts for overall and transfer posttest scores showed statistically significant results for the combination of the PM and SM groups scoring higher on overall scores compared to the combination of the M and PSM groups. Results for both overall and transfer scores also showed the combination of the PM and SM groups scores were statistically significantly higher than the M group's scores. Furthermore, results for overall scores showed the combination of the SM and PM groups scores were statistically significantly higher than the PSM group's scores. Results for transfer also showed statistically significant results for the SM group scoring higher on transfer scores compared to the M group. See Appendix J for the detailed 2x2 ANOVA output.

These findings imply pretraining and modality or segmenting and modality were better than modality alone or pretraining, segmenting, and modality for overall scores. These findings also imply segmenting and modality is better than modality alone for transfer scores, although either two-way combination (PM or SM) seemed to have resulted in better transfer learning than the three-way combination or modality alone. Although there were no other statistically significant differences found, some p-values approached statistical significance, when $\alpha = 0.05$. Because of the small effect sizes close to significance, a power analysis was performed. The power was not large for the sample; therefore, the power analysis revealed a second experiment could increase the power. Recommendations for this second experiment will be discussed in Chapter V. The findings described in the previous sections are new to the field and interesting. Chapter V discusses the implications of this study for future research and the instructional design field.

CHAPTER V

Conclusion

This study was conducted to determine if different combinations of pretraining, segmenting, and modality compared to modality alone influenced learners' overall, recall, and transfer posttest scores. As part of the study, the researcher developed four treatments that taught an overview of the consumer decision making process. The four treatments included modality (M); modality and pretraining (PM); modality and segmenting (SM); and modality, pretraining, and segmenting (PSM). Learners were randomly assigned to one of the four treatment groups. See Chapter III for a detailed description of each treatment and the methods used in this study.

All groups received the same instructional content and materials; however, the way the content was presented varied between the four treatment groups. Generative activities for recall and transfer were provided. The activities were placed within the instructional lesson at different times. Placement was determined by the instructional methods used in each group. These activities were provided at the end of the entire lesson for the M group. For the pretraining group (PM), these activities were provided at the end of the pretraining section and at the end of the main lesson. For the segmenting group (SM), the active segmenting breaks included generative activities at the end of each main segment. For the treatment group with all three principles (PSM), these activities were included at the end of the pretraining lesson and at the end of each unit in the main lesson.

At the end of the treatment, all learners were asked to complete the same posttest, which consisted of ten recall and ten transfer questions. This study only analyzed posttest data and did not include a pretest or any other type of preassessment. The guiding research questions for this study were:

1. Do any of the four combinations of the use/non-use of the pretraining and segmenting principles, combined with modality, cause an increase in college learners' overall scores for an online test of consumer decision-making knowledge?

   Research hypotheses for question 1 ($\alpha = 0.05$):

   H_0: There is no significant difference in overall posttest scores between the PSM, PM, SM, and M groups.

   H_1: There is at least one significant difference in overall posttest scores between the PSM, PM, SM, and M groups.

2. Do any of the four combinations of the use/non-use of the pretraining and segmenting principles, combined with modality, cause an increase in college learners' recall scores for an online test of recall of consumer decision-making knowledge?

   Research hypotheses for question 2 ($\alpha = 0.05$):

   H_0: There is no significant difference in posttest recall scores between the PSM, PM, SM, and M groups.

   H_1: There is at least one significant difference in posttest recall scores between the PSM, PM, SM, and M groups.

3. Do any of the four combinations of the use/non-use of the pretraining and segmenting principles, combined with modality, cause an increase in college learners' transfer scores for an online test of transfer of consumer decision-making knowledge?

   Research hypotheses for question 3 ($\alpha = 0.05$):

   H_0: There is no significant difference in posttest transfer scores between the PSM, PM, SM, and M groups.

H_1: There is at least one significant difference in posttest transfer scores between the PSM, PM, SM, and M groups.

This chapter discusses the experimental results and the implications these results have on practice and research. This chapter also provides recommendations for both future practice and research.

Discussion of Experimental Results

Results were divided to answer each research question. The results found to address these questions are discussed in future sections.

Results for Research Question 1

The results for overall posttest scores showed no statistically significant main effect for pretraining [F (1, 129) = .025, p = .874] or for segmenting [F (1, 129) = .035, p = .851]. However, the results showed a statistically significant interaction effect for overall scores [F (1, 129) = 4.383, p = .038]. Because of the statistically significant interaction effect, seven planned contrasts were performed.

As mentioned in Chapter IV, contrasts for overall scores showed statistically significant differences with the combination of the PM and SM groups scoring higher than the combination of the M and PSM groups. The combination of the PM and SM groups scores were statistically significantly different than the M group's scores and the combination of the SM and PM groups scores were statistically significantly different than the PSM group's scores.

These findings imply either the combination of pretraining and modality or the combination of segmenting and modality may be most effective to manage intrinsic load when compared to the use of the combination of pretraining, segmenting, and modality or modality alone. Using the combination of pretraining, segmenting, and modality may have reduced learning outcomes due to additional cognitive load. Implications of overall posttest findings will be further discussed in a later section of this chapter.

Results for Research Question 2

The results of the recall assessment items showed no statistically significant differences among the four treatment groups as there was no main effect for pretraining [$F(1, 129) = .187$, $p = .666$], no main effect for segmenting [$F(1, 129) = 1.185$, $p = .278$] and no interaction effect for pretraining and segmenting [$F(1, 129) = 1.068$, $p = .303$]. These results showed there were no statistically significant differences among any of the four groups for recall scores. The most direct interpretation of these results is the differences between the groups in recall posttest scores were due to random chance. Each of the methods used (modality; pretraining and modality; segmenting and modality; and pretraining, segmenting, and modality) were statistically equivalent for recall scores.

Recall scores may have shown no statistically significant differences because the learners in this study have already established their own methods for recalling information, regardless of teaching methods used. The learners in this study were high school graduates, which may have been enough educational experience to previously develop individual strategies to recall low-level information, such as facts and basic concepts. The learners' existing recall learning strategies may have concealed any treatment differences in recall level learning. Without a large effect size in this study, as shown in Chapter IV, there were no differences among the four treatment groups for being able to recall information; therefore, different multimedia methods did not increase the learners' ability to recall information. Implications of these findings will be discussed later in this chapter.

Results for Research Question 3

Results for transfer questions showed no statistically significant main effect for pretraining [$F(1, 129) = .002$, $p = .961$] and no statistically significant main effect for segmenting [$F(1, 129) = .213$, $p = .645$]. However, there was a statistically significant interaction effect [$F(1, 129) = 3.984$, $p = .048$]. Because of the statistically significant interaction effect, nine planned contrasts were performed.

As described in Chapter IV, findings from the contrast analysis for transfer showed statistically significant differences for the SM group scoring higher compared to the M group. Other contrasts showed the combination of PM and SM groups scored statistically significantly different for transfer than the combination of the M and PSM groups and the combination of the PM and SM groups scored statistically significantly different compared to the M group.

The three-way combination of principles caused lower posttest transfer scores than any of the other groups compared to any of the groups with only two principles applied (SM and PM). These findings imply using either pretraining and modality or segmenting and modality may be a more effective instructional designs than modality alone and the three-way combination of pretraining, segmenting, and modality transfer scores. Implications of these findings will be discussed later in this chapter.

Similar to the results described in research question one, including one principle in the treatment (M) was not as good as including two principles (PM or SM), but including all three principles (PSM) brought transfer scores back down. Too many principles all trying to solve the same problem may have increased cognitive load and interfered with the learner’s ability to transfer knowledge. It may be that because pretraining and segmenting are dividing the content in different ways, there were too many divisions (or segments) in the lesson that included pretraining, segmenting, and modality. Too much time could have elapsed between the pretraining segment and information at the end of the module. When the learners got to the last segment, they may have forgotten important information presented at the beginning of the pretraining section.

Possible Explanation of the Results

Results showed using a combination of either pretraining and modality or segmenting and modality to break up the lesson was enough to effectively manage the learners' intrinsic load for overall and transfer scores. The three-way combination of pretraining, segmenting, and modality showed no statistically different results for overall, recall, or transfer scores compared to modality alone, the combination of pretraining and modality, or the combination of segmenting and modality. The most direct interpretation of these results is that using three principles to reduce intrinsic load did not provide any additional learning benefits for any type of learning (recall, transfer, or overall) measured in this study.

These results are similar to the redundancy effect described by Mayer and Fiorella (2014). These authors found a potential problem with redundancy between on screen text and spoken words. When redundant information is present, learners may try to compare the printed and spoken words, which uses their limited cognitive capacity for items that are not essential to learning (Mayer & Fiorella, 2014). Although these authors' findings were in a different context, using a combination of the three principles (segmenting, pretraining, and modality) to manage intrinsic load may have also imposed additional extraneous load. In this study, redundancy acts as a metaphor for trying to manage intrinsic load with three principles: pretraining, segmenting, and modality. Combinations of two principles (pretraining and modality or segmenting and modality) were more optimal for learning than the combination of the three principles (pretraining, segmenting, and modality). The following paragraphs explain why the combination of three principles to manage intrinsic load could have been redundant.

As discussed in Chapter III, pretraining and segmenting broke up the lesson into smaller chunks (units) in different ways. Because the combinations of either pretraining and modality or segmenting and modality was enough, combining the three principles (pretraining, segmenting, and modality) may have broken up the content in too many ways. According to Clark and Mayer (2016), in some cases, “more is less” (p. 139). In a similar manner, using a combination of pretraining, segmenting, and modality may have caused a cognitive/affective dissonance or a split attention effect that reduced transfer and overall learning. Extraneous processing could have interfered with the learners’ ability to relate items that were separated in time (temporal continuity). For the PSM group, there could have been too much time between the pretraining unit and the last unit on extended decision making. This temporal separation is described below.

Split attention effect. As mentioned earlier, pretraining and segmenting broke up the content in different ways. When the breaks provided with both pretraining and segmenting were combined, there may have been too much time between the different portions of instruction for learners to connect the content in later segments with the pretraining content. Sweller et al. (2011) stated when learners are required to split their attention between related pieces of information, such as through spatial and temporal separations, additional extraneous cognitive load may be created. According to Sweller et al. (2011), multiple sources of related but separate information can be integrated into a single source of information by aligning them spatially and temporally. An instructional designer can use different instructional strategies to integrate materials by reducing temporal and spatial separations in the instructional content. Jumping from a pretraining section to segmented units may have caused a temporal separation within the instructional content. This temporal separation could have imposed additional cognitive load and reduced learning. There is a possibility that the combination of pretraining, segmenting, and modality may have led to a violation of the temporal contiguity principle.

Using all three principles may have broken up the instruction in ways that were not conducive for optimum instruction and learning. For example, after the pretraining section, learners may have still been trying to hold key vocabulary words and concepts in their working memory before continuing to the remaining segments. Because learners in the PSM group were required to integrate the pretraining concepts with different segments of content in the remaining units, this could have imposed additional cognitive load on the learners. Although learners were encouraged to take a break after the pretraining section, this was not enforced by the researcher. If learners did not take a break after the pretraining unit, they may not have been able to completely encode the information in long term memory; therefore, they might not have developed a full understanding of the information. This lack of understanding could have impacted their learning in the later segments.

If learners were forced to use a large portion of their working memory resources to understand low-level items, such as definitions and concepts, they may have not been able to connect the pretraining content to the remaining topics covered in the following units (segments). One way to improve the learners' understanding of the pretraining content is interleaving, which is described as variability of practice of the task (van Merriënboer & Kirschner, 2018). Interleaving, or overlapping practice (van Merriënboer & Kirschner, 2018), may have helped learners better recall and transfer the information from one segment to the next. Different but related activities could have been designed, such as realistic scenarios, where the learner was able to make different decisions. For example, this lesson covered four main concepts: purchase involvement, nominal decision making, limited decision making, and extended decision making. Instead of providing practice activities (questions) that followed this flow (concept 1, concept 2, concept 3, concept 4), interleaving would have structured the practice activities in a different flow to provide variability of practice. This overlapping practice would have tested the learners' decision-making skills in some combination that was different from the flow of the instructional content. The pretraining content could have been woven into practice activities in the unit(s) that followed the pretraining unit to allow learners to practice recalling and transferring pretraining information and make connections between the pretraining unit and the remaining unit(s).

Affective effect. In addition to the possibility of a split attention effect described in the paragraphs above, there was also the possibility of a cognitive/affective effect. The Cognitive-Affective Theory of Learning with Media (CATLM; Moreno 2005; Park, et al., 2015) suggests affect and motivational factors impact the amount of cognitive resources a learner uses for a learning task. The learners' perception of the content, such as their motivation to learn about the topic or their interest in learning about types of consumer decision making, could have impacted posttest scores as described below.

If learners were motivated to learn, they were more willing and likely to make their cognitive resources available for learning the presented content. Because a combination of either pretraining and modality or segmenting and modality was enough for optimal learning, extraneous load may have been created while trying to reduce intrinsic load. This extraneous load could have been imposed by the combination of pretraining, segmenting, and modality in the instructional strategy. Including a combination of these three principles to manage intrinsic load may have also impacted the learners' motivation to learn and their perception of the content. Implications of this potential effect will be discussed later in this chapter.

Possible Effects Due to the Research Design

Although this study was designed to minimize as many limitations and delimitations as possible, it was impossible for the researcher to mitigate all potential factors that could have created a false negative or positive. The following paragraphs discuss the possible applicable limitations and delimitations of this study.

Treatment length. All four treatments were relatively short (~15 minutes), which could have limited the treatment effect. The researcher expected it would take an average of 30 minutes to complete both the lesson and posttest. The short duration of the study may have reduced the effect of the treatments and thus lowered the chances of finding statistically significant differences if the learners did not have enough time to practice and encode the information to create new schemata. Schemata may not have been encoded correctly until after the assignment. It is possible some learners may have created false or incorrect schemata, which could have impacted results. Extending the duration of the treatment over the course of a semester may have provided additional time for the learners to create schemata. A longer duration study would provide more time to encode information and create schema, which may alter some non-statistically significant results.

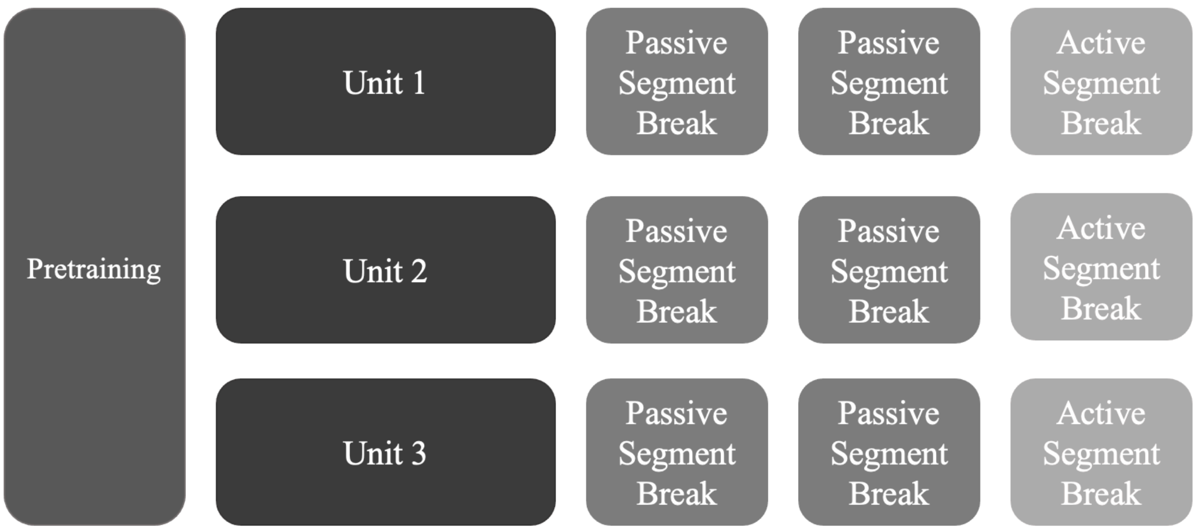
Unequal treatment group participation. There were less participants in the PSM group (n= 27) than the PM group (n= 30), SM group (n= 38), or M group (n= 38). This was due to participation rate, incomplete data, exclusion criteria, or no consent (further discussed in Chapters III and IV). There is a possibility that a factor within the PSM treatment may have caused more learners to opt out of the study compared to the M or SM groups. We have a similar, but less, concern for the PM treatment. If learners chose to not participate or allow their data to be used because of a systematic reason, such as how the principles were combined, then the results of the study could have been impacted. Perhaps more learners chose to not participate or consent for their data to be used in the PSM group than the other groups because a temporal contiguity violation resulted in less participation or consent. This idea will be further discussed in the next section.

Cognitive overload factors. Although breaking instructional materials into segments has shown to manage learners' intrinsic load (Mayer & Chandler, 2001; Mautone & Mayer, 2007; Mayer et al., 2003; Mayer et al., 2018; Mayer et al., 2019; Sung & Mayer, 2013), segmenting the instruction after the pretraining lesson could have increased the learners' cognitive load. Because learners in the pretraining, segmenting, and modality (PSM) group were required to integrate the pretraining concepts with different segments of content in the remaining units, this could have imposed additional cognitive load on the learners. Although learners were encouraged to take a break after the pretraining section, this was not enforced by the researcher. If learners did not fully encode the new knowledge from the pretraining section as schema in long-term memory, they might not have developed a fully accessible understanding of the information when they learned subsequent content. This lack of understanding could have impacted their learning in the later segments as learners were trying to make sense of the essential content plus process the new information related to each essential topic.

For the groups who received a treatment with the use of pretraining received a pretraining lesson at the beginning of the instruction. This is illustrated in Figure 8 below. For the PM group, they received one continuous lesson with the remaining information after the pretraining lesson with an active break at the end of the pretraining lesson and the end of the continuous lesson. For the PSM group, after the pretraining lesson and active break, they received two more lessons with passive segment breaks within the lesson and active segment breaks at the end of each lesson. This combination of pretraining and segmenting may have been suboptimal for learning as a violation of temporal contiguity between the segments could have resulted in additional cognitive load.

Figure 8

Instructional Strategy with Pretraining Unit at Beginning of Module



Note. This graphic shows how pretraining was included with segmenting in this study.

The way the content was split up could have created cognitive dissonance and violated the temporal contiguity principle. Lessons were segmented by passive and active segment breaks. The first items covered in the pretraining were covered shortly after the necessary pretraining information was needed in the next unit. The pretraining chunk and the next segment had a bigger interval of time between pretraining and the lesson. The pretraining for the last lesson had even a bigger content interval between the pretraining items and the items covered in the lesson. The cognitive load factors may have increased as the module continued because of the way the pretraining and segmenting were designed in this study. Pretraining at the beginning of the module instead of pretraining for each lesson, may have been a less effective combination of pretraining and segmenting. This will be discussed further in the recommendations for future research portion of this chapter.

Fatigue factors. Since the PSM group had the most segments, maybe their motivation was lacking as they had participation fatigue. Too many segments in the PSM group could have resulted in fatigue, which could have decreased motivation. If learners got bored or fatigued, they may have scored lower on the content test. In this study, fatigue is referred to as an affective effect (or response). It wasn't physical fatigue that made learners tired. Although the consumer decision making lesson was relatively short, learners may have gotten bored with, or tired of, the clicks after four segments (one pretraining and three units), in addition to a passive break after each slide. Each segment ranged from thirty seconds to one minute and fifteen seconds. Natural breaks in the content were used to determine the active and passive segmenting breaks.

Because learners in the PSM group had to click through four segments (pretraining and three units), they may have experienced "click fatigue" because the lesson provided passive breaks at the end of each slide and active breaks at the end of each segment. Posttest scores for learners in the PSM group may have been impacted by the number of segments included in the lesson. Using all three principles to manage intrinsic load may have overloaded the learners and caused a lack of motivation to continue towards the end of lesson.

This study did not assess how much time a learner spent on each question. What if learners got lost and did not know when they would be done with the instruction and posttest? Learners may have wanted to be done with the treatment and a possible reason could have been the number of segments in the PSM group. A progress bar may have helped address this issue. A progress bar will be further discussed later in this chapter.

Situational interest. In addition to the possibilities described above, learners may have had no interest in learning about marketing or consumer decision making. Although marketing majors should be interested in how consumers make decisions compared to others, not all learners who participated were marketing majors. The personal finance course chosen for this study is considered a general education requirement at the university. Learners may have seen no relevance of the topic. This could have decreased their motivation.

Learners' motivation for learning about marketing concepts could have impacted their posttest scores. Learners may have been interested in learning about marketing at the beginning of the lesson, but then became less interested as the lesson progressed. Interest is part of the ARCS model (motivation may have been nonexistent and scores were lower. Because participants were randomly assigned to one of four groups, it is expected that learners who were not motivated were spread out equally over the four groups. This is mentioned here because it is further addressed for recommendations for future research and practice.

Recommendations

Based on the findings previously described, this study provides several practical suggestions for instructional designers and researchers. The findings from this study provides suggestions for how instructional designers can use a combination of multimedia principles to manage intrinsic load (foster essential processing). Because existing literature in the field has not studied these multimedia principles in combination, future research is needed to better understand how instructional designers can manage intrinsic load with a combination of pretraining, segmenting, and modality. The following sections discuss recommendations for future practice and research.

Recommendations for Future Practice

Although pretraining, segmenting, and modality have shown evidence to manage intrinsic load effectively on their own (Ayres, 2006; Cheon et al., 2013; Clark et al., 2005; Eitel et al., 2013; Kester et al., 2006; Lawson & Mayer, 2021; Lusk et al., 2008; Lusk et al., 2009; Mariano, 2014; Mayer & Chandler, 2001; Mayer et al., 2002; Mayer et al., 2003; Mayer et al., 2017; Mayer et al., 2018; Mayer & Pilegard, 2014; Moreno, 2007; Pollock et al., 2002; Rey et al., 2019; Schroth, 2000), it may not be necessary to use all three principles in a single lesson. Outside of research settings, instructional designers in the real-world deal with time and money constraints. Because of these constraints, design and development time may be reduced by not using a combination of all three pretraining, segmenting, and modality together. The three-way combination did not result in more learning; therefore, professional instructional designers and educators may save time and money by not providing all three principles in lessons. Based on the results of this experimental study, there are several practical recommendations for instructional designers.

Since there were no additional improvements when applying a combination of the three principles, implementation of a combination of either pretraining and modality or segmenting and modality may be sufficient for overall and transfer learning. It is recommended that instructional designers use a combination of either pretraining and modality or segmenting and modality instead of applying all pretraining, segmenting, and modality for higher overall and transfer scores.

There were also no additional improvements when applying only modality. Implementation of a combination of either pretraining and modality or segmenting and modality may be sufficient for overall and transfer learning. It is recommended that instructional designers use a combination of either pretraining and modality or segmenting and modality instead of modality alone for higher overall and transfer scores.

If instructional designers want learners to recall information, modality may be enough. Recall scores showed no statistically significant differences between the four treatment groups. A possible reason for this is throughout their educational experiences, learners may have already established their own methods for recalling information. Since these learners may have already developed their own methods for recalling information, they may still be able to recall information even when different teaching methods are used. The same methods that are effective for recall may not be effective for transfer. The ways learners memorize key facts for recall may not the same as learning for knowledge transfer; therefore, it is recommended that instructional designers consider using only modality when learners need to recall information.

It is inefficient for instructional designers to assume more instructional strategies will result in the most optimum learning. Instructional designers cannot assume because all principles, individually, have shown evidence to reduce intrinsic load, that a combination of all three is the best for learning. Careful consideration of the overall goal (recall or transfer) is needed, as well as intentionally choosing when to apply a combination of the different principles to better manage intrinsic load.

Recommendations for Future Research

Researchers in the field have not studied the three multimedia principles (pretraining, segmenting, and modality) that manage intrinsic load in combination. Because of the lack of existing literature on this topic as well as the findings from this study, there are several recommendations for future research.

The findings from this study may be expanded by a follow up study to see if the power can be increased with more participants. The data in this study revealed a small effect size (see Appendix J). Because of this small effect, a power analysis was conducted to further explore the possibility of a future study with a larger sample size. The power analysis revealed a replication study would need approximately 124 people per group to have a 95% chance of observing a statistically significant effect size. Because of the power analysis results, it is recommended to replicate this study with a larger sample to test for a larger effect size.

If the findings from this study can be confirmed, modality alone may be enough in some cases, such as when learners need to recall information. Furthermore, include all three principles (pretraining, segmenting, and modality) may be too much for learners and create dimensioned learning results. The lack of significant main effects for well-known and studied multimedia learning principles, such as pretraining and segmenting, indicates the presences of modality in all groups and/or the presence of a group with modality, segmenting, and pretraining is impacted by a more complex relationship between these three principles. This complex relationship needs to be studied more. The field could benefit from future research confirming a combination of either pretraining and modality or segmenting and modality is the most effective for managing intrinsic load in some cases.

Learners may have wanted to be done because the PSM group had the most segments. It was not physical fatigue what would have made them tired, rather there could have been something in the treatment group that mentally fatigued the learners. It was expected that this group took the longest time because of the passive and active segment breaks. Since PSM group had the most segments, perhaps their motivation was lacking and had participation fatigue.

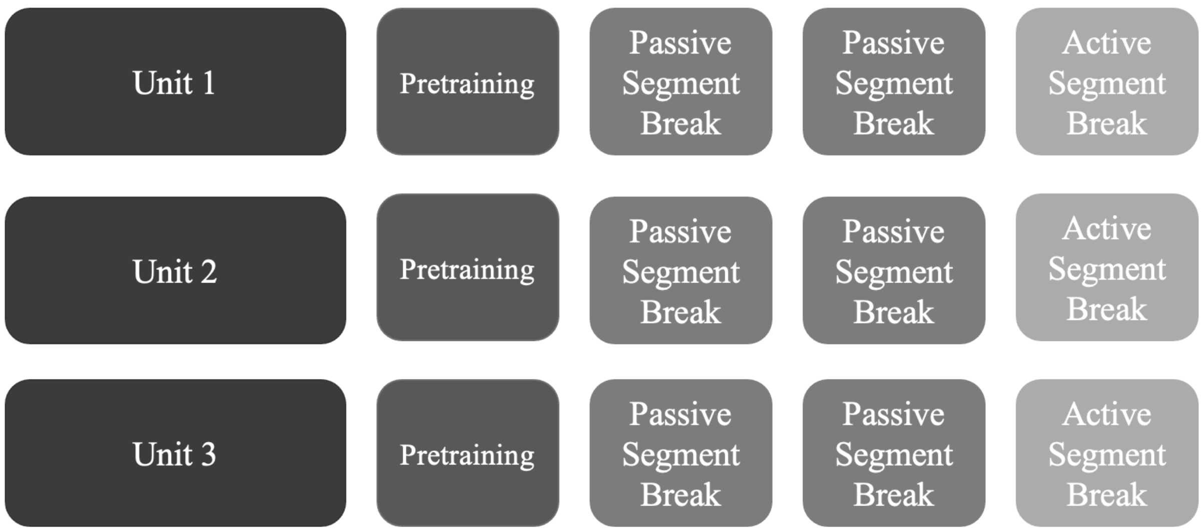
A progress bar may have provided learners with a better understanding of their progress and where they were at in the module. It is recommended to consider a progress bar in a future study to provide insight into how a progress bar may reduce learner fatigue. Perhaps a progress bar would have avoided the fatigue issue by letting them know they were nearing the end. Also, motivation could have been measured directly. It is recommended to do a study or studies that address either the direct measurement of motivation or the effect of a progress bar in order to reduce fatigue.

This study compared the combinations of pretraining and segmenting with the consistent presence of modality. Conducting a similar study without modality in any groups' treatments could provide more information about the interaction of segment and pretraining. This can be tested by conducting a study comparing pretraining, segmenting, and pretraining and segmenting without the use of modality. According to Park, et al., (2015), "the format of combining pictorial information with narration still is one of the most optimal methods of instruction" (p. 277). Maybe modality interacts with pretraining and segmenting in a way that overloads the learner with extraneous design. Further research on how these principles interact may address some of these questions.

Figure 8 (shown above) shows how pretraining and segmenting were used in combination in this study. Figure 9 below illustrates a different way of structuring the combination of pretraining and segmenting. Providing pretraining at the beginning of each lesson may reduce the temporal separation between the pretraining content and the content covered in the later lesson(s). By pretraining learners on the key components of each lesson, or segment, the cognitive dissonance of the way the content was split up may have been reduced. It is recommended that a study be replicated with pretraining within each segmented unit, such as to compare Figure 8 and Figure 9. This replication study would compare pretraining on all topics prior to segmenting to pretraining within each segmented unit.

Figure 9

Instructional Strategy to Include Pretraining in Each Segment



Note. This graphic shows how pretraining could be included with segmenting in a different combination than the combination used in this study.

In additional to how the principles work in combination, the instructional topic chosen for this study may have been too simple to adequately assess the findings for complex content. Future research could use a different topic for the treatments and replicate the study to see if a different, or more complex topic, achieves different overall, recall, and transfer posttest scores. There is a possibility that different combinations of principles may work differently depending on the content area. Future research is needed to assess if different combinations impact posttest scores differently among a variety of content areas.

Another possibility is the content was complex enough, but a different instructional design model may have been more effective. For example, the Kemp Model (Morrison et al., 2013). This model was chosen because it focused on four main design elements important for instructional design consideration: learners, objectives, methods, and evaluation. This model seemed to address the necessary design elements for the instructional topic; however, a different model such as van Merriënboer's four component instructional design (4C/ID) model may have been better for the complex topic.

This study only considered immediate transfer. The posttest was administered immediately after the treatment; therefore, immediate recall and transfer were assessed. Future research should also look at delayed transfer as delayed transfer could provide different results, as the learners would have had more time to develop new schemata. Managing cognitive load with a combination of two or more principles (PM, SM, or PSM) may have a different impact on delayed transfer. Assessing delayed transfer would provide learners with time to fully develop new schema and to process the information in the instruction. Results might reveal different combinations of principles are better for delayed transfer.

Lastly, this study did not consider motivation and affective domain factors. Motivation, fatigue, self-efficacy, situational interest, or other affect factors could have impacted learning for a variety of reasons. Future research could replicate the study and incorporate motivational and affect factors that may influence posttest scores. For example, Keller's (1987) ARCS instructional design model focuses on motivation. This model is used to consider four motivational components of instructional design: attention, relevance, confidence, and satisfaction. Keller (1987) noted the importance of motivating learners throughout the duration of the instruction.

In addition to using the ARCS instructional design model, the Instructional Materials Motivation Survey (IMMS), developed by Keller (2010), could provide data on learners' reactions to the instructional materials through the lens of the ARCS model. This 36-item survey would provide the opportunity to measure learners' scores on attention, relevance, confidence, and satisfaction to create a cumulative motivation score (Keller, 2010).

Summary

This study examined if different combinations (pretraining and modality; segmenting and modality; pretraining, segmenting, and modality; or modality alone) was better for overall, recall, and transfer scores for an introductory personal finance course at a medium-sized university in the intermountain west. The theoretical framework for this study was based on cognitive load theory (CLT) and the cognitive theory of multimedia learning (CTML). The lesson, regardless of treatment group, was designed to help participants manage their intrinsic load with four different combinations of multimedia principles. It was expected there would be a statistically significant difference between the four treatment groups for overall, recall, and transfer scores.

The data collected from the sample was analyzed to answer three main research questions. The first research question asked if any of the four combinations of the use/non-use of the pretraining and segmenting principles, combined with modality, caused an increase in overall scores for an online test of consumer decision-making knowledge. Results of the 2x2 MANOVA for overall scores showed no statistically significant main effect for pretraining and no statistically significant main effect for segmenting. However, results showed there was a statistically significant interaction effect for overall scores. Because of the significant interaction effect, planned contrasts were performed. These contrasts further revealed the combination of the PM and SM groups scored statistically significantly higher than the combination of the M and PSM groups.

The second research question asked if any of the four combinations of the use/non-use of the pretraining and segmenting principles, combined with modality, caused an increase in recall scores for an online test of consumer decision-making knowledge. Results for recall showed no statistically significant differences among the four treatment groups as there was no main effect for pretraining, no main effect for segmenting, and no interaction effect for pretraining and segmenting. The planned contrasts also showed no statistically significant results for recall.

The third research question asked if any of the four combinations of the use/non-use of the pretraining and segmenting principles, in concert with modality, caused an increase in transfer scores for an online test of consumer decision-making knowledge. Results of the 2x2 MANOVA for transfer scores showed no statistically significant main effect for pretraining and no statistically significant main effect for segmenting. However, results showed there was a statistically significant interaction effect for transfer scores. Because of the significant interaction effect, planned contrasts were performed. These contrasts further revealed the combination of the PM and SM groups scored statistically significantly higher than the combination of the M and PSM groups. In addition to this statistically significant finding, the results for another contrast revealed applying segmenting and modality was more likely to raise transfer scores than applying modality alone for transfer.

Based on the findings from this study, future research is needed to further study the complex relationship between pretraining, segmenting, and modality to manage intrinsic load. Although the findings from this study agree with previous research showing the principles can manage intrinsic load, the results also suggest there may be different combinations of the principles that work for different types of learning. Different combinations of the pretraining, segmenting, and modality principles should be studied to continue to add to the research on managing intrinsic load with multimedia principles.

This study provided valuable insights and recommendations worthy of consideration by instructional designers and researchers. These insights and recommendations are applicable for the use of instructional strategies intended to implement multimedia principles, manage intrinsic load, and facilitate meaningful learning when designing and developing instructional materials.

In conclusion, more is sometimes less. Instructional designers, practitioners, and educators need to intentionally consider the instructional strategies they are using and the context in which they are using them. Without considering how different strategies interact with one another, learning may be hindered by including too many strategies or principles aimed at the same goal. In this study, the goal was to manage essential processing; however, using more principles to manage essential processing was not always best for learning.

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Figure 1: Human Memory Processing Model Permission

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Mark.

Dr. Mark Freeman (he/him)

Senior Lecturer

EIS Academic Program Director - INTI, Malaysia and UOW in Dubai

School of Computing and Information Technology

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APPENDIX B

Test Blueprint

Recall

Learning Objective	Number of Test Items	Point Value	(%) Weight of Test
1. Define purchase involvement.	1	1	7
2. Differentiate between a low-involvement purchase and a high-involvement purchase.	3	3 (1 pt. for each question)	22
3. Classify nominal, limited, and extended decision making.	2	2 (1 pt. for each question)	14
4. Show the impact of purchase involvement on the decision process.	1	1	7
5. Follow the consumer decision making process.	3	7 (one multiple choice response with 5 pts. possible – 1 pt. for each answer; two questions worth 1 pt. each)	50
	Total	**14**	**100%**

Transfer

Learning Objective	Number of Test Items	Point Value	(%) Weight of Test
1. Define purchase involvement.	0	0	0
2. Differentiate between a low-involvement purchase and a high-involvement purchase.	2	6 (two select all that apply questions – one worth 4 pts., one worth 2 pts., one pt. for each correct answer)	21
3. Classify nominal, limited, and extended decision making.	4	9 (three multiple choice – 1 point each, one categorization – 6 points – 1 point for each correct answer)	32
4. Show the impact of purchase involvement on the decision process.	2	10 two select all that apply questions – 1 point for each correct answer; 6 points and 4 points)	36
5. Follow the consumer decision process	2	3 (one multiple choice – 1 point, one select all that applies – 1 point each, 2 points total)	11
	Total	**28**	**100%**

APPENDIX C

Recall and Transfer Knowledge Checks and Posttest Questions

Recall Review Questions:

1. What is an example of nominal decision making (from the lesson)?
    a. Milk
    b. **Toothpaste**
    c. Cheese

2. What is a repeat purchase?
    a. You buy one brand of a certain product because it meets your needs.
    b. You have enduring involvement with one brand and one product so you always buy it.
    c. **You buy one product and don't consider anything other than the product itself.**

3. What type(s) of decision making would you be involved in if you conducted an external information search?
    a. Nominal
    b. **Limited**
    c. **Extended**

4. As a consumer, what types of evaluation could you conduct throughout the decision-making process?
    a. **Alternative**
    b. Novel
    c. **Post purchase**
    d. Extensive

Transfer Review Questions:

1. How is a purchase for emotional reasons different than a more functional purpose?
    a. If a consumer has emotions about a purchase, a brand that satisfies their needs may have a foot in the door because of product credibility.
    b. **If a consumer has emotions about a purchase, a brand that satisfies their needs may have a competitive differentiation compared to other brands.**
    c. If a consumer has emotions about a purchase, a brand may not need to launch a lot of marketing campaigns because the consumer already knows what they want.

2. Categorize each item shown as either nominal, limited, or extended decision making.
    a. Orange juice **(nominal)**
    b. A wedding **(extended)**
    c. Home décor **(limited)**
    d. Pet food **(nominal)**
    e. A home renovation **(extended)**
    f. A birthday gift for a family member **(limited)**

3. You recently purchased a new laptop for school after an extensive internal and external information search. What do you do next?
    - **a. Conduct a thorough evaluation to determine how well the laptop meets your evaluative criteria. You may rate your satisfaction based on each of the evaluative criteria you identified as important.**
    - b. Don't think about the purchase again and never mention it to your friends or family.
    - c. Revisit the purchase after a year or so and determine if you're satisfied or not.

Recall Posttest Questions:

1. What is the highest level of consumer decision making?
    - a. Nominal
    - b. Limited
    - c. **Extended**

2. What are the five steps in the consumer decision making process?
   (Fill in the title of each step)
   - Step 1: **Problem recognition**
   - Step 2: **Information search**
   - Step 3: **Alternative evaluation**
   - Step 4: **Purchase**
   - Step 5: **Post purchase**

3. What is an example of limited decision making (from the lesson)?
    - a. **Purchasing cheese**
    - b. Purchasing milk
    - c. Purchasing a house
    - d. Purchasing cleaning products

4. What is purchase involvement?
    - a. The level of concern for, or interest in, the purchase process initiated by the need for a particular product.
    - b. **The level of concern for, or interest in, the purchase process initiated by the need to make a particular purchase**.
    - c. The level of concern for, or interest in, the influence of a friend or family member's purchase.

5. What is the first step in the decision-making process?
    - a. **Problem recognition**
    - b. Information search
    - c. Alternative evaluation

6. What step do limited and extended decision making have that nominal doesn't?
    - a. Problem recognition
    - b. Information search
    - c. **Alternative evaluation**

7. What step in the decision-making process could a consumer ask friends or family for advice on a purchase?
    a. Problem recognition
    b. **Information search**
    c. Alternative evaluation

8. What is it called when a consumer regrets a big purchase?
    a. **Post purchase dissonance**
    b. Post purchase evaluation
    c. Post purchase depression

9. A consumer is ___________ __________when they only buy one brand of a product?
    a. Repeat purchase
    b. **Brand loyal**
    c. Dedicated consumer

10. What is the difference between the three levels of consumer decision making types?
    a. **The purchase involvement of the consumer**
    b. The product involvement of the consumer
    c. The difficulty level of acquiring the purchase

Transfer Posttest Questions:

1. What is an example of nominal decision making?
    a. **Soda**
    b. 3D printer
    c. Vacation

2. What is an example of limited decision making?
    a. Tortilla chips
    b. **Lawnmower**
    c. Inventory for your new business

3. What is an example of extended decision making?
    a. Deodorant
    b. Freezer
    c. **A new RV**

4. Which of the following are factors that may influence a consumer's desired state? *Drag each item to the "factor" or "not a factor" group depending on the item's influence on a consumer's desired state*

   Factor
   a. Culture/subculture
   b. Social or financial status
   c. Reference group(s)
   d. Household characteristics
   e. Previous decisions
   f. Individual development, emotions, motives, situation

   Not a factor (None)

5. Which of the following factors may influence a consumer's actual state? For each listed factor, drag the slider to 0 if there is no influence and 10 if there is an influence.
   a. Past decisions **(10)**
   b. Normal depletion **(10)**
   c. Product/brand performance **(10)**
   d. Availability of products **(10)**

6. Take the role of a marketer. How could you use the consumer decision making process?
   a. **A marketer can use the process to identify consumer needs and show how their product/service can solve the need.**
   b. A marketer doesn't really use the process. It's more for the consumer but it's important for a marketer to understand what the consumer is doing.
   c. A marketer can use the process to identify what other marketers are doing to appeal to customers.

7. Categorize the following as either nominal, limited, or extended decision making.
   a. Women's spa - **Limited**
   b. Hawaiian vacation resort - **Extended**
   c. Fire alarm battery replacement - **Nominal**
   d. Car service – **Nominal (possibly limited – maybe you recently moved or previously had a bad experience)**
   e. Air conditioner filters - **Nominal**
   f. Health insurance – **Extended**

8. Which of the following is *not* a way to determine your satisfaction with the purchase?
   a. Conduct a post-purchase evaluation
   b. Rate your satisfaction based on the evaluative criterion
   c. **Look at reviews and determine if other people liked it**

9. Assume the role of a marketer. What types of questions could you ask to measure the satisfaction of a consumer who bought new clothing? Categorize the following questions as questions you would either ask or wouldn't ask.
   I would ask this question.
   a. Did the clothing fit as expected?
   b. Would you buy this item again?
   c. Would you recommend this item to friends/family?
   d. What was the most important criteria this item met to initiate your purchase?
   I wouldn't ask this question
   e. How many items did you purchase?
   f. What size of items did you buy?
   g. What is your favorite brand of [clothing type]?

10. Which of the following is **not** an example of why marketers are interested in having brand loyal customers?
    a. Committed customers are unlikely to search for additional information when making a purchase.
    b. They're more receptive to product changes, trying new products, and engaging in word of mouth with their friends and family.
    c. **Brand loyal customers aren't as important as repeat purchasers because repeat purchasers buy the same item over and over.**

APPENDIX D

Analysis

Topic
Types of Consumer Decision Making

Goal Statement
Learners will show the impact of purchase involvement on the decision process.

Needs Analysis

- Target Audience
  - First or second-year university students enrolled in an introductory business course
- Learner Characteristics
  - Will be identified in the demographic survey
- Felt Needs
  - Introductory business students feel the need to know more about business, the impacts of different processes/decisions, etc. that may influence their major and career decisions.
  - Most learners choose to attend college because they feel a need between their current performance/position/skills and desired performance/position/skills. Felt needs may even consist of the need to do better in life, to get a better paying job, or an aspiration to have a better quality of life with a college education.
- Expressed Needs
  - Learners are expressing the need to know more information by attending university courses. They have willingly enrolled in this course and expressed the need to learn about basic business areas and topics.
- Anticipated/Future Needs
  - It is expected that graduates will need to know about types of consumer decision making upon graduating with a business or marketing degree. Learners should anticipate and expect that this information will provide value to their future roles and responsibilities. Learners also anticipate that they will need to know the introductory information in higher lever business courses in order to successful graduate and perform up to industry expectations upon graduation.

Learner Analysis

- General Characteristics
  - These characteristics will be identified in the demographic survey (See chapter 3 for more details or Appendix B for the survey questions).
- Specific Entry Characteristics
  - There are no prerequisites to enroll in the university course.
- Academic Information
  - Major subject areas studied will be interpreted to be business since most students enrolled in this course are exploring the field of business and are interested in being a business major. Academic information, such as GPA, standardized test scores, etc. will not be gathered as they are not applicable to this study.

- Personal and Social Characteristics
    - It is assumed that a majority of the learners will be between the ages of 18 and 20. There will be some nontraditional learners such as adults who have had different prior careers, postponed going to college, looking for career advancement, etc.
    - It is assumed that most learners will have a favorable attitude towards business since most of them are exploring being a business major. Enrollment in the course is voluntary and everyone has made a choice to go to college, so it is assumed most learners are motivated and willing to learn.
    - It is assumed that most learners have limited previous and current employment or work experience directly in business. Since it is expected that most learners are traditional students, they would have limited experience other than entry level jobs worked during high school. It is also assumed that most first-year university students work a student job of some sort. A small proportion of nontraditional learners will bring unique previous and current employment and work experience to this course.
    - It is expected that there will be a diverse group of learners in this course. This will be assessed in the demographic survey.
    - Learners with significant learning disabilities will not be included in this study. This study is intended to assess the "typical" learner.
    - All learners in this course will be adults. Adult learning principles will be considered and applied during the design.

Task Analysis
Facts:

- Definitions/vocabulary:
    - Purchase involvement: "The level of concern for, or interest in, the purchase process triggered by the need to consider a particular purchase."
    - Nominal decision making: "Involves no further consideration or decision making"
    - Brand loyal purchase: "A brand you are committed to because it meets your needs"
    - Repeat purchase: "A product purchased over and over again without much importance placed on anything but the product itself"
    - Limited decision making: "Involves internal and limited external search, few alternatives, simple decision rules on a few attributes, and little post purchase evaluation"
    - Extended decision making: "Involve an extensive internal and external information search followed by a complex evaluation of multiple alternatives and significant post purchase evaluation"
    - Problem recognition: "The result of a discrepancy between a desired state and an actual state that is sufficient to arouse and activate the decision process"
    - Actual state: "The way an individual perceives his or her feelings and situation to be at the present time"
    - Desired state: "The way an individual wants to feel or be at the present time"
- Concepts

Topic Analysis

- Purchase involvement
    - Define
    - Categorize different purchases and the level of involvement
- Nominal Decision Making
    - Problem Recognition
        - Selective
    - Information Search
        - Limited internal
    - Purchase
        - Brand Loyal Purchases
        - Repeat Purchases
    - Post purchase
        - No dissonance
        - Very limited evaluation
- Limited Decision Making
    - Problem Recognition
        - Generic
    - Information Search
        - Internal
        - Limited external
    - Alternative Evaluation
        - Few attributes
        - Simple decision rules
        - Few alternatives
    - Purchase
    - Post purchase
        - No dissonance
        - Limited evaluation
    - Examples and categorization
- Extended Decision Making
    - Problem Recognition
        - Generic
    - Information Search
        - Internal
        - External
    - Alternative Evaluation
        - Many attributes
        - Complex decision rules
    - Examples and categorization

APPENDIX E

Objectives

Segmenting - Pretraining Sequence	Segmenting - No Pretraining Sequence
Lesson 1: Purchase Involvement Learners will: • Define purchase involvement. • Differentiate between a low-involvement purchase and a high-involvement purchase. Lesson 2: The Consumer Decision Process Learners will: • Classify selective and generic problem recognition. • Classify different types of information searches. • Describe attributes, decision rules, and alternatives. • Differentiate dissonance and no dissonance. • Define evaluation types. Lesson 3: Types of Decision Making Learners will: • Differentiate nominal, limited, and extended decision making.	Lesson 1: Types of Decision Making – Nominal Decision Making Learners will: • Describe the nominal decision-making process. Lesson 2: Types of Decision Making – Limited Decision Making Learners will: • Describe the limited decision-making process. Lesson 3: Types of Decision Making – Extended Decision Making Learners will: • Classify selective and generic problem recognition. • Classify different types of information searches. • Describe attributes, decision rules, and alternatives. • Differentiate dissonance and no dissonance. • Define evaluation types. • Describe the extended decision-making process. • Differentiate nominal, limited, and extended decision making.

No Segmenting - Pretraining Sequence	No Segmenting - No Pretraining Sequence
Learners will: • Define purchase involvement. • Differentiate between a low-involvement purchase and a high-involvement purchase. • Classify selective and generic problem recognition. • Classify different types of information searches. • Describe attributes, decision rules, and alternatives. • Differentiate dissonance and no dissonance. • Define evaluation types. • Differentiate nominal, limited, and extended decision making.	Learners will: • Differentiate between a low-involvement purchase and a high-involvement purchase. • Describe the nominal decision-making process. • Describe the limited decision-making process. • Classify selective and generic problem recognition. • Classify different types of information searches. • Describe attributes, decision rules, and alternatives. • Differentiate dissonance and no dissonance. • Define evaluation types. • Describe the extended decision-making process. • Differentiate nominal, limited, and extended decision making.

APPENDIX F

Content Sequencing

<table>
<tr><th>Lesson</th><th>Segmenting – Pretraining Sequence</th></tr>
<tr><td>Lesson 1: Purchase Involvement</td><td>Define purchase involvement.
Categorize different purchases and the level of involvement.</td></tr>
<tr><td>Lesson 2: The Consumer Decision Process</td><td>Problem Recognition
Selective
Generic
Information Search
Limited internal
Internal
Limited external
External
Alternative Evaluation
Attributes
Decision rules
Alternatives
Purchase
Post purchase
No dissonance
Dissonance
Evaluation
Very limited
Limited
Complex</td></tr>
<tr><td>Lesson 3: Types of Decision Making</td><td>Nominal Decision Making
Problem Recognition
Information Search
Purchase
Post purchase
Examples and categorization
Limited Decision Making
Problem Recognition
Information Search
Alternative Evaluation
Purchase
Post purchase
Examples and categorization
Extended Decision Making
Problem Recognition
Information Search</td></tr>
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<tr><td></td><td>
<li style="list-style:none">
Alternative Evaluation
Purchase
Post purchase
Examples and categorization

</td></tr>
<tr><th>Lesson</th><th>Segmenting – No Pretraining Sequence</th></tr>
<tr><td>Lesson 1: Types of Decision Making – Nominal Decision Making</td><td>
Nominal Decision Making

Problem Recognition
Selective
Information Search
Limited internal
Purchase
Define purchase involvement.
Categorize different purchases and the level of involvement.
Brand Loyal Purchases
Repeat Purchases
Post purchase
No dissonance
Very limited evaluation
Complex
Examples and categorization

</td></tr>
<tr><td>Lesson 2: Types of Decision Making – Limited Decision Making</td><td>
Limited Decision Making

Problem Recognition
Generic
Information Search
Internal
Limited external
Alternative Evaluation
Few attributes
Simple decision rules
Few alternatives
Purchase
Define purchase involvement.
Categorize different purchases and the level of involvement.
Post purchase
No dissonance
Limited evaluation

</td></tr>
</table>

<table>
<tr><td></td><td><li style="list-style:none">
Examples and categorization</td></tr>
<tr><td>Lesson 3: Types of Decision Making – Extended Decision Making</td><td>Extended Decision Making
Problem Recognition
Generic
Information Search
Internal
External
Alternative Evaluation
Many attributes
Complex decision rules
Many alternatives
Purchase
Define purchase involvement.
Categorize different purchases and the level of involvement.
Post purchase
Dissonance
Complex evaluation
Examples and categorization</td></tr>
</table>

No Segmenting – Pretraining Sequence
- Purchase Involvement   - Define purchase involvement.   - Categorize different purchases and the level of involvement.   - The Consumer Decision Process   - Problem Recognition   - Selective   - Generic   - Information Search   - Limited internal   - Internal   - Limited external   - External   - Alternative Evaluation   - Attributes   - Decision rules   - Alternatives   - Purchase   - Post purchase   - No dissonance   - Dissonance   - Evaluation   - Very limited   - Limited   - Complex   - Nominal Decision Making   - Problem Recognition   - Information Search   - Purchase   - Post purchase   - Examples and categorization   - Limited Decision Making   - Problem Recognition   - Information Search   - Alternative Evaluation   - Purchase   - Post purchase   - Examples and categorization   - Extended Decision Making   - Problem Recognition   - Information Search   - Alternative Evaluation

- Purchase
- Post purchase
- Examples and categorization

No Segmenting - No Pretraining Sequence

- Nominal Decision Making
    - Problem Recognition
        - Selective
    - Information Search
        - Limited internal
    - Purchase
        - Define purchase involvement.
        - Categorize different purchases and the level of involvement.
        - Brand Loyal Purchases
        - Repeat Purchases
    - Post purchase
        - No dissonance
        - Very limited evaluation
    - Examples
- Limited Decision Making
    - Problem Recognition
        - Generic
    - Information Search
        - Internal
        - Limited external
    - Alternative Evaluation
        - Few attributes
        - Simple decision rules
        - Few alternatives
    - Purchase
        - Define purchase involvement.
        - Categorize different purchases and the level of involvement.
    - Post purchase
        - No dissonance
        - Limited evaluation
    - Examples
- Extended Decision Making
    - Problem Recognition
        - Generic
    - Information Search
        - Internal
        - External
    - Alternative Evaluation
        - Many attributes
        - Complex decision rules
        - Many alternatives
    - Purchase

        - Define purchase involvement.
        - Categorize different purchases and the level of involvement.
    - Post purchase
        - Dissonance
        - Complex evaluation
    - Examples

APPENDIX G

Outline

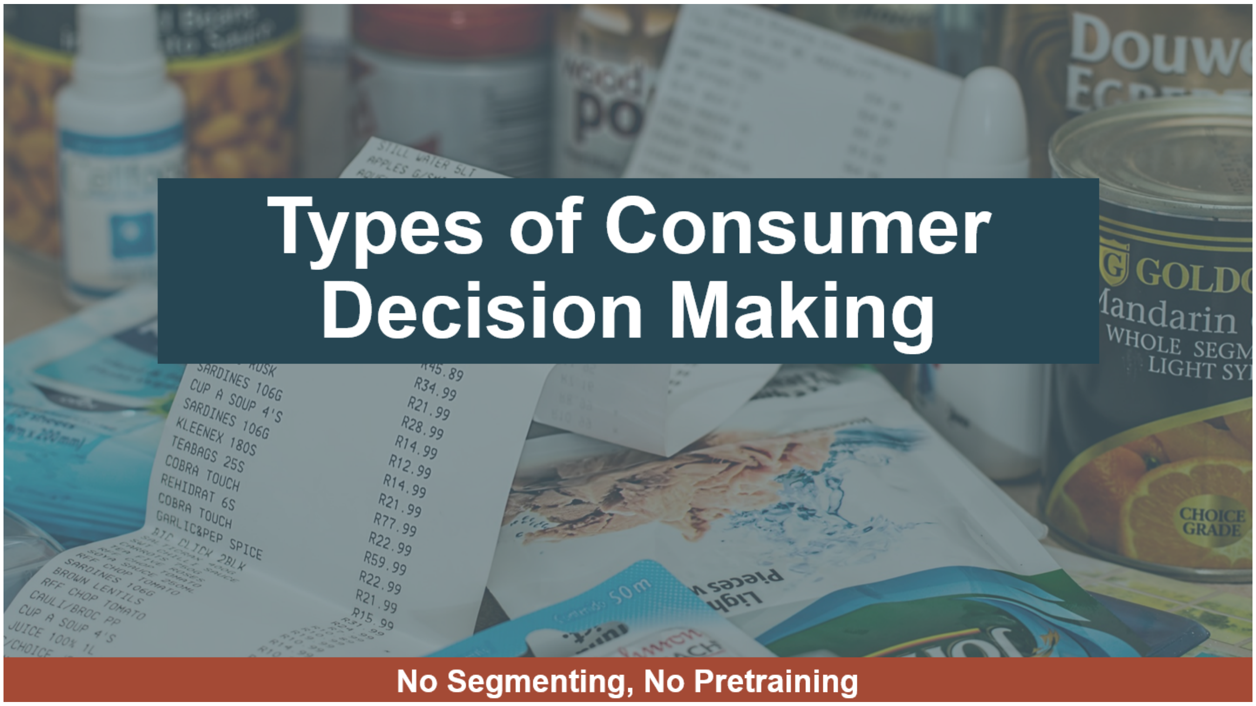
<table>
<tr><th>Segmenting - Pretraining Sequence</th><th>Segmenting – No Pretraining Sequence</th></tr>
<tr>
<td>Lesson 1: Purchase Involvement
eLearning Presentation:
Overview of purchase involvement
Define and provide examples of a low-involvement purchase and a high-involvement purchase.
Lesson 2: The Consumer Decision Process
eLearning Presentation:
Define and provide an example of selective and generic problem recognition.
Classify and provide examples of different types of information searches- limited internal, internal, limited external, and external.
Define attributes, decision rules, and alternatives.
Define and provide examples of dissonance and no dissonance.
Define and provide examples of evaluation types.
Lesson 3: Types of Decision Making
eLearning Presentation:
Show the process and examples of nominal, limited, and extended decision making.</td>
<td>Lesson 1: Purchase Involvement
eLearning Presentation:
Overview of purchase involvement
Define and provide examples of a low-involvement purchase and a high-involvement purchase.
Lesson 2: Types of Decision Making – Nominal Decision Making
eLearning Presentation:
Show the nominal decision-making process.
Define each step in the process.
Lesson 3: Types of Decision Making – Limited Decision Making
eLearning Presentation:
Show the limited decision-making process.
Define each step in the process.
Lesson 4: Types of Decision Making – Extended Decision Making
Learners will:
Show the nominal decision-making process.
Define each step in the process.</td>
</tr>
</table>

No Segmenting - Pretraining Sequence	No Segmenting - No Pretraining Sequence
eLearning Presentation: • Define and provide an example of selective and generic problem recognition. • Classify and provide examples of different types of information searches- limited internal, internal, limited external, and external. • Define attributes, decision rules, and alternatives. • Overview of purchase involvement • Define and provide examples of a low-involvement purchase and a high-involvement purchase. • Define and provide examples of dissonance and no dissonance. • Define and provide examples of evaluation types. • Show the process and examples of nominal, limited, and extended decision making.	eLearning Presentation: • Show the nominal decision-making process. • Define each step in the process. • Show the limited decision-making process. • Define each step in the process. • Show the nominal decision-making process. • Define each step in the process.

APPENDIX H

PowerPoints and Accompanying Narration

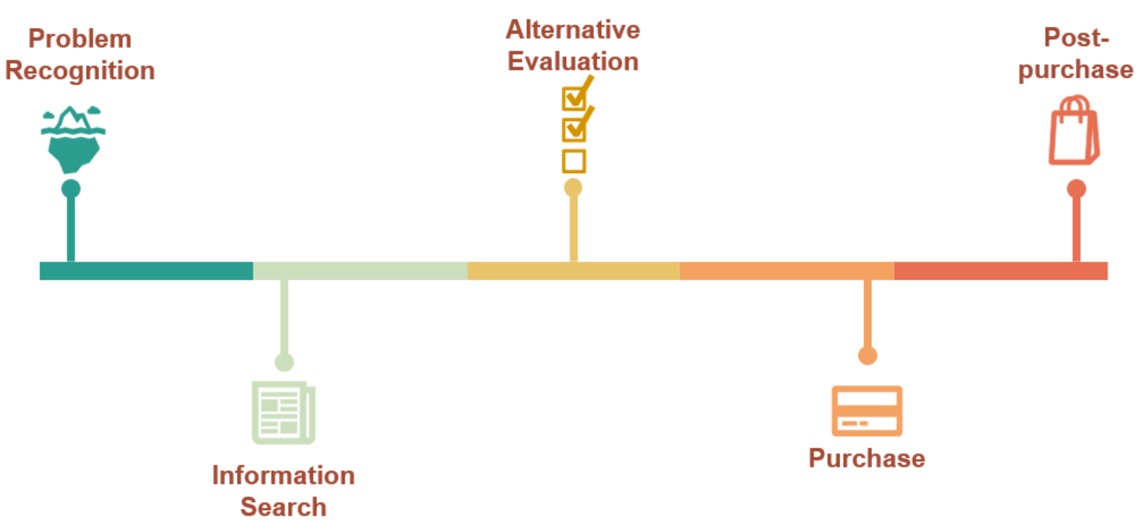
M Treatment


Types of Consumer Decision Making
No Segmenting, No Pretraining

3 Types of Consumer Decision Making

Narration: There are three types of decisions that consumers make: nominal, limited, and extended. According to Mothersbaugh & Hawkins (2016), purchase involvement is “The level of concern for, or interest in, the process triggered by the need to consider a particular purchase” (p. 450-451).

Consumer Decision Making Process



Narration: When making a purchase, the consumer decision making process consists of five steps. These five steps include problem recognition, information search, alternative evaluation, purchase, and post purchase. Nominal decision making only consists of four of the five steps, as nominal decision making doesn’t include an alternative evaluation.

Problem Recognition

Narration: The first step in the consumer decision making process is problem recognition. The consumer recognizes that they need to acquire something (i.e., make a purchase) to get them to their desired state. A need can arise when a consumer recognized an emotional or situational need. Once the consumer has recognized a problem, they move onto the information search.

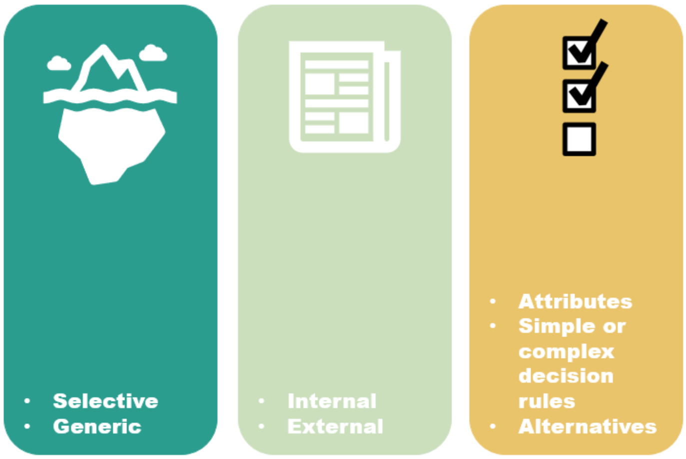
Information Search

Narration: The information search in nominal decision making is limited internal. This search is conducted by retrieving information from long-term memory to provide a single solution. An example of this is running out of ketchup. You always buy Heinz so you'll buy Heinz again. You recognized a problem between your actual state (no ketchup) and desired state (having ketchup) so you retrieve information from your long-term memory (I like Heinz ketchup).

The information search in limited decision making is internal, with a limited external search. This search is conducted by retrieving information from long-term memory as well as considering a very limited examination of other options. For example, you need to purchase cheese. You remember that Tillamook cheese is good and you don't like the individually wrapped cheese slices. You have a very limited examination of a "do not buy" option. You may also go to the store and purchase the cheapest brand of cheese. You may choose to ask a friend or family member their favorite brand or recall a commercial you saw on TV last night.

Extended decision making involves an extensive internal and external search. The consumer relies on internal information has been both actively and passively acquired through past searches, personal experiences, and low-involvement learning as well as external information, such as independent groups, personal contacts, marketing information, and experience.

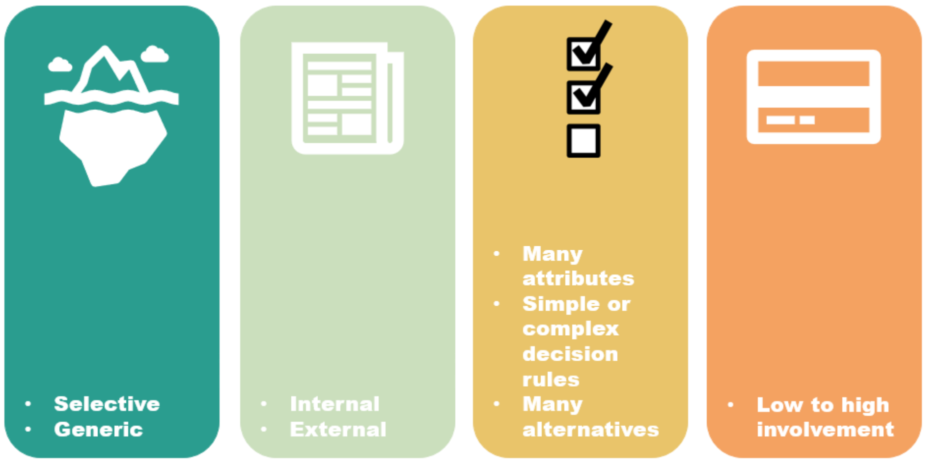
Alternative Evaluation



Narration: Nominal decision making does not include alternative evaluation because there is no decision involved. Think back to the ketchup example, you purchase Heinz ketchup without considering alternative brands, products, or attributes. Limited decision making involves few attributes and alternatives and simple decision rules. You may only consider one or two desirable features/characteristics. You may have a decision rule that you buy the new brand or product because you are bored with the current, satisfactory brand or you buy the cheapest brand of an item available. Only a few alternatives are considered. At the grocery store down the cheese aisle, you may consider Tillamook and Kroger cheese.

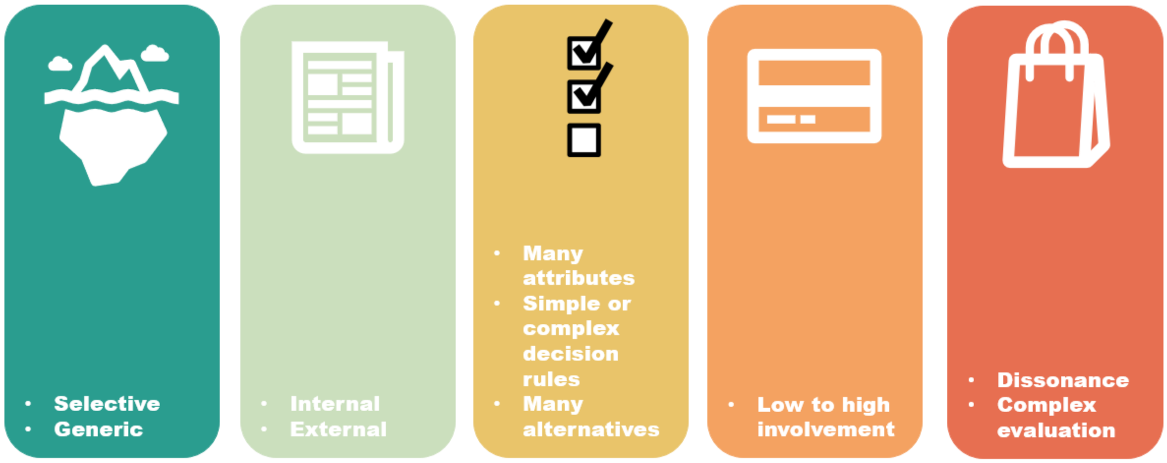
In extended decision making, once the information search has been completed, the consumer performs a complex evaluation of many attributes and alternatives and complex decision rules. An example is buying a car. There are many attributes and alternatives you are considered, like year, miles, maybe brand/manufacturer, features, and so on. You may use complex decision rules and establish minimum performance standards for evaluative criterion and select brands that meet or exceed those expectations. You may also establish a minimum level of performance for each important attributes and then select brands that meet or exceed those expectations on any attribute. You may rank the evaluative criterion in order of importance and establish a cut off point.

Purchase



Narration: Nominal decision making is a low-involvement purchase because there's little to no decision involvement. A decision that is completely nominal does not consider alternatives to purchase. Limited decision making in its simplest form is very similar to nominal decision making. It falls in the middle of nominal and extended decision making. There is still low purchase involvement and little effort is involved in making the purchase decision. Extended decision making is the highest level of purchase involvement. The consumer may spend hours, days, or even weeks considering the problem, the information they have found, and their alternative evaluation.

Post Purchase



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The Decision Making Process

Type	Decision Making Process				
	Problem Recognition	Information Search	Alternative Evaluation	Purchase	Post Purchase
Nominal	Selective	Limited internal	None	Low involvement	• No dissonance • Very limited evaluation
Limited	Generic	• Internal • Limited external	• Few attributes • Simple decision rules • Few alternatives	Medium involvement	• No dissonance • Limited evaluation
Extended	Generic	• Internal • External	• Many attributes • Complex decisions rules • Many alternatives	High involvement	• Dissonance • Complex evaluation

Narration: Nominal decisions involve selective problem recognition, meaning one brand can solve the consumer's problem. A problem is recognized when a consumer perceives a discrepancy between their actual state and desired state. Actual state is the way an individual perceives his or her feelings at the current moment. Desired state is what an individual wants to feel or be at the current moment.

Nominal decision making is habitual decision making. It involves no decision. A limited internal information search is conducted and a purchase is made. This purchase is either brand loyal or repeat. A brand loyal purchase means there's a brand you are committed to because it meets your needs. A repeat purchase is a product purchased over and over again without much importance place on anything but the product itself. After the purchase there is no dissonance and very little evaluation.

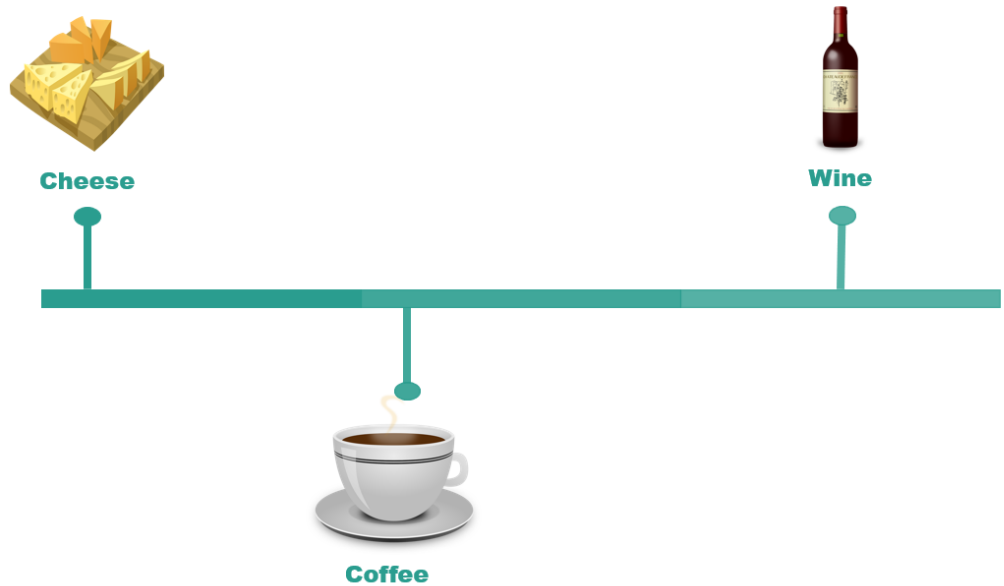
Limited decisions involve generic problem recognition, meaning more than one brand can solve the consumer's problem. An internal and limited external information search is conducted. Few attributes and alternatives are considered and simple decision rules are used. The purchase is made and there is little dissonance or evaluation post purchase.

Extended decisions involve generic problem recognition and an extensive internal and external information search. Many attributes and alternatives are considered and complex decision rules are used. The purchase is made. Dissonance is felt and a complex evaluation is conducted post purchase. Extended decisions involve generic problem recognition and an extensive internal and external information search. Many attributes and alternatives are considered and complex decision rules are used. The purchase is made, dissonance is felt, and a complex evaluation is conducted post purchase.

Nominal Decision Making - Examples

Narration: The first example of nominal decision making that was talked about is ketchup. Another example is toothpaste. One morning you realize you're about out of toothpaste. You add toothpaste to your grocery list and a few days later, you're in the store and look for Colgate without comparing price, ingredients, or alternative brands. Another example is cleaning products. You know what works and what doesn't work. When you need to purchase new cleaning products, you buy what you always buy. You most likely don't buy a new type of dish soap every time you run out.

Limited Decision Making – Examples



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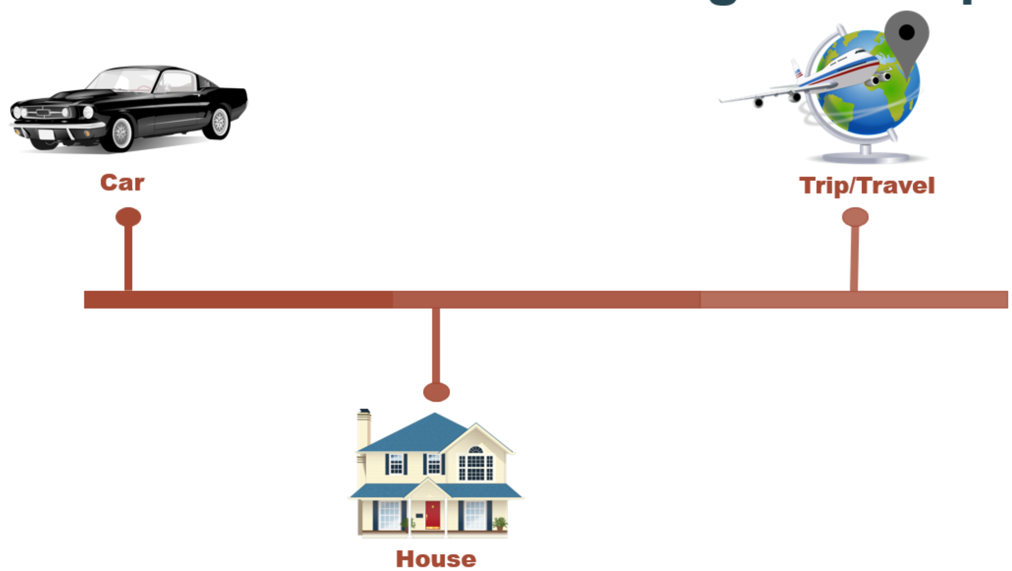
Extended Decision Making – Examples



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A consumer may be contemplating a decision to take a trip. There is an unlimited number of places to go, a variety of different attributes that are considered when planning a trip. Are you going to visit your parents or go to a relaxing destination? Do you want to travel abroad or stay in the United States? Mountains or beak? Tourist attractions? Time of year? Costs? Fly or drive?

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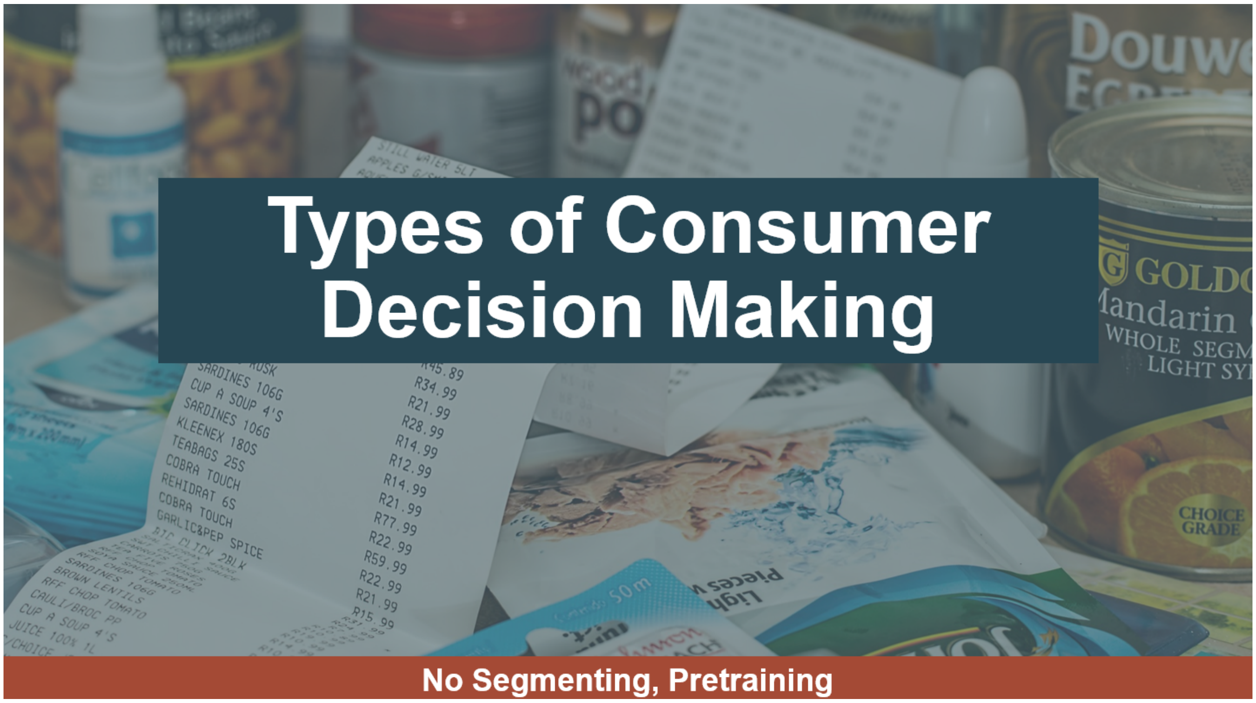
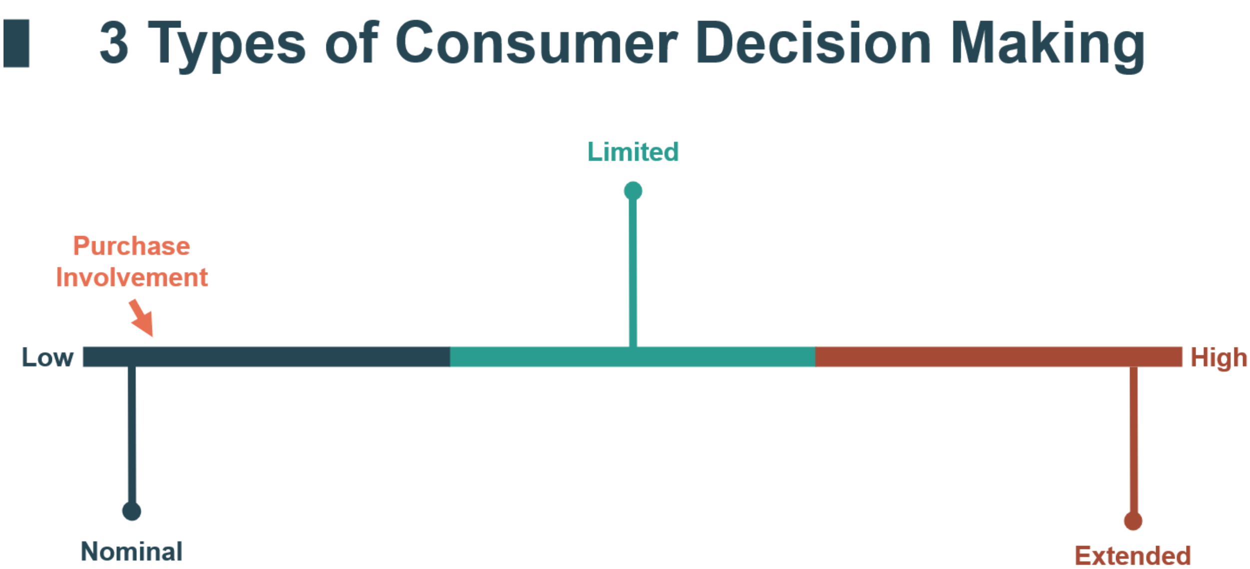
Narration: To wrap up, problem recognition can be selective or generic. Information searches can consist of internal and/or external searches. For higher involvement, attributes, decision rules, and alternatives are considered. Purchases range from low to high involvement and may consist of post purchase dissonance and evaluation. Nominal decision making is the lowest level of purchase involvement and extended decision making is the highest.

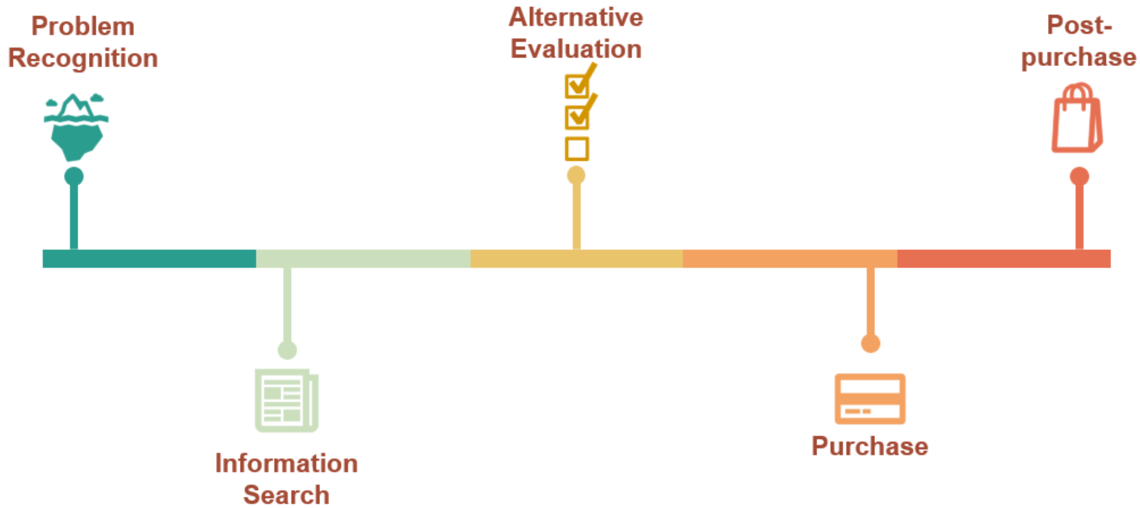
PM Treatment





Narration: There are three types of decisions that consumers make: nominal, limited, and extended. According to Mothersbaugh & Hawkins (2016), purchase involvement is “The level of concern for, or interest in, the process triggered by the need to consider a particular purchase” (p. 450-451).

Consumer Decision Making Process



Narration: When making a purchase, the consumer decision making process consists of five steps. These five steps include problem recognition, information search, alternative evaluation, purchase, and post purchase. Nominal decision making only consists of four of the five steps, as nominal decision making doesn't include an alternative evaluation.

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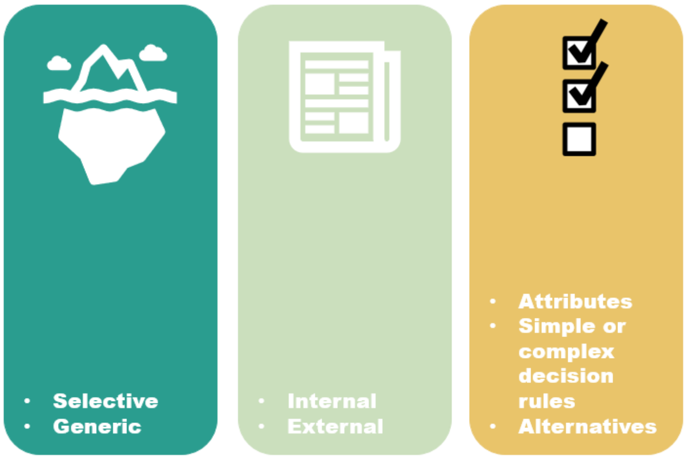

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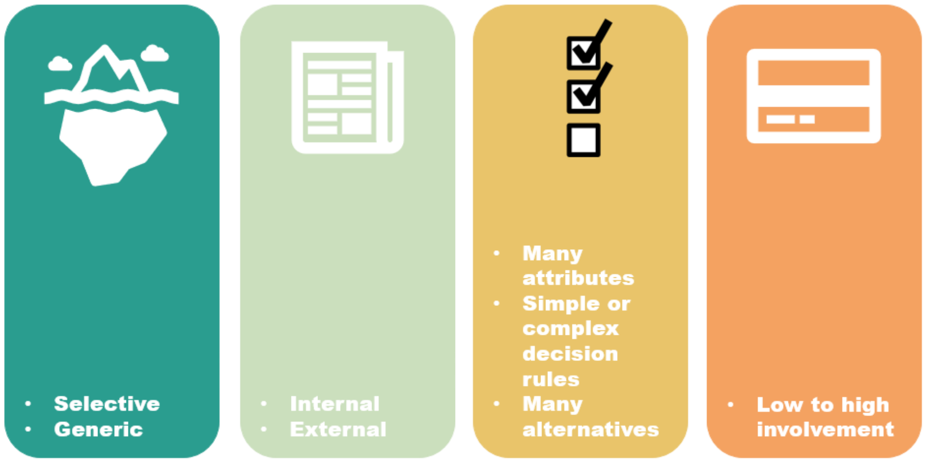

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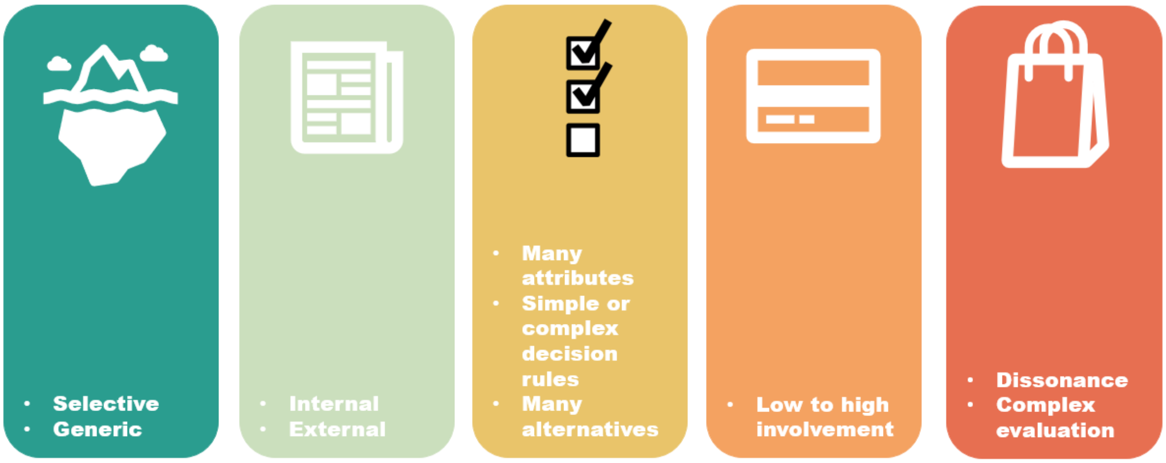
Post Purchase



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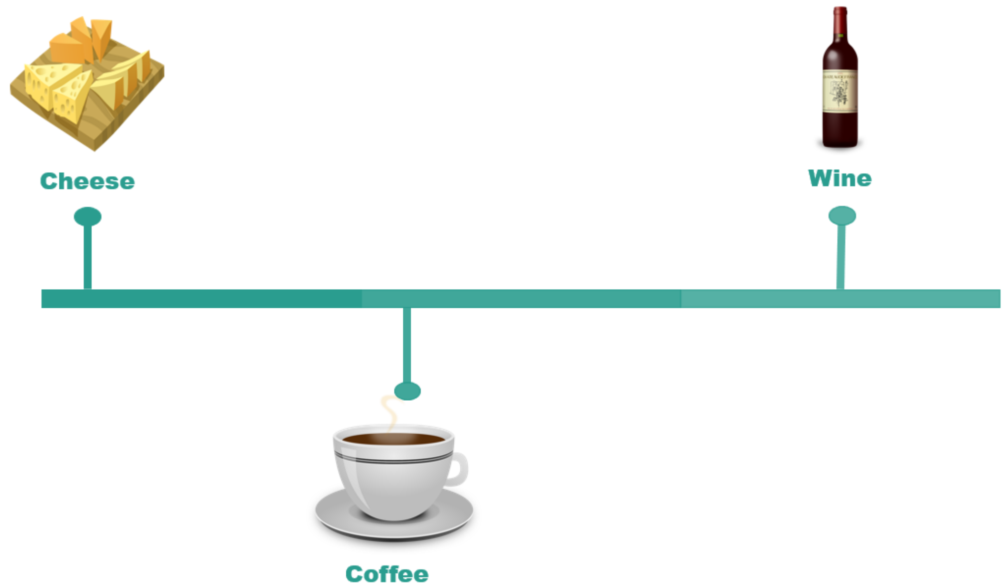
Limited Decision Making – Examples



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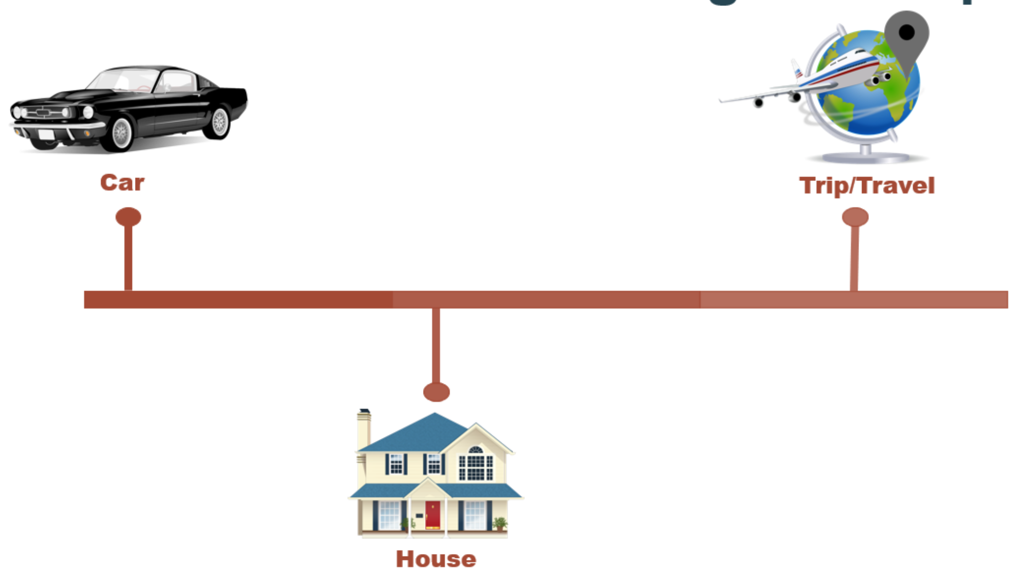

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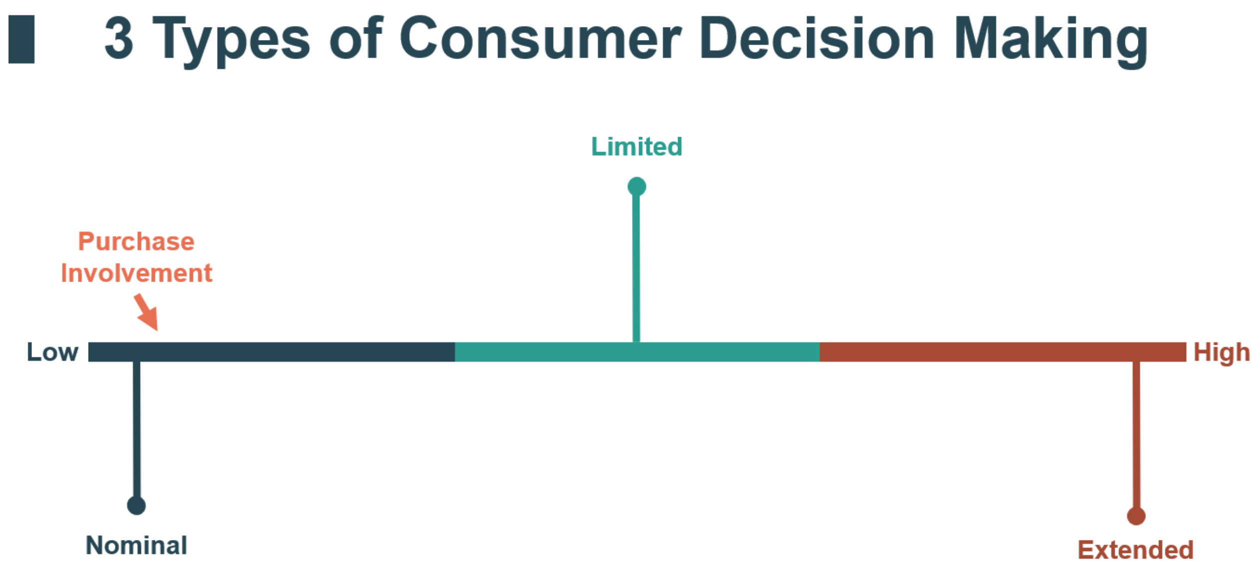

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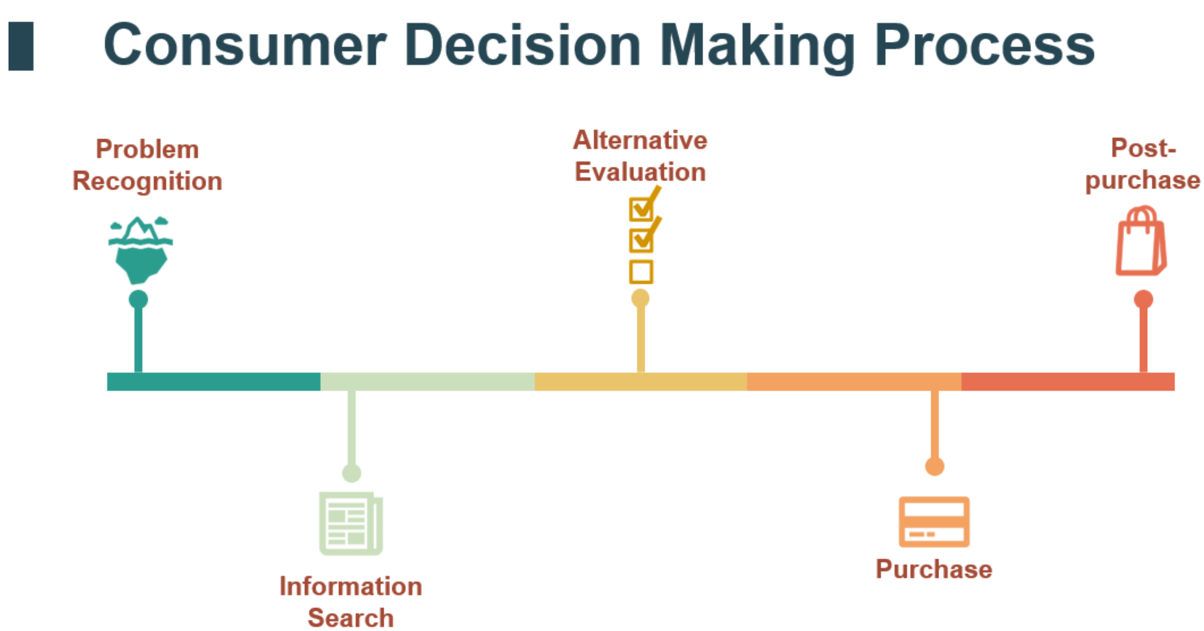

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[Passive segment break]

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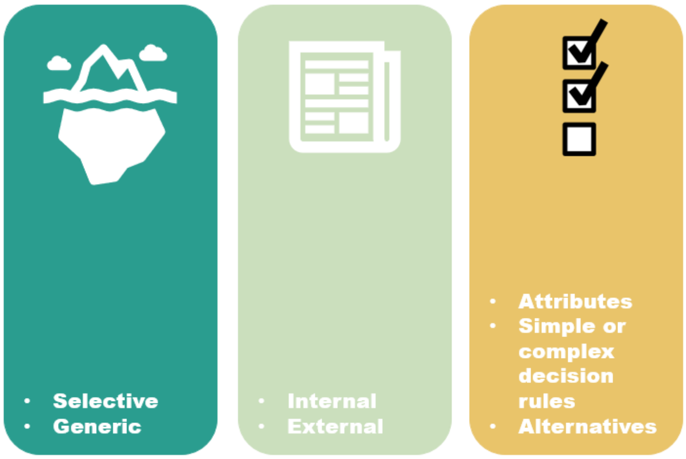

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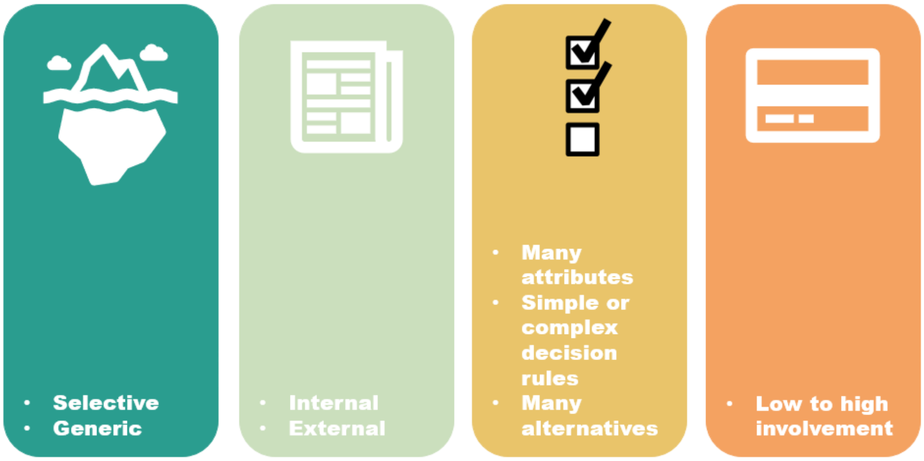

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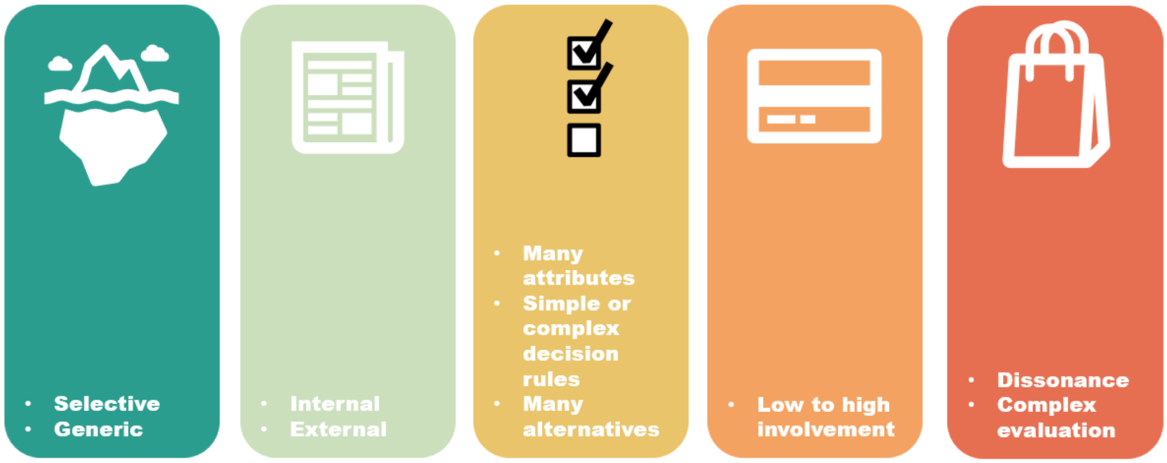

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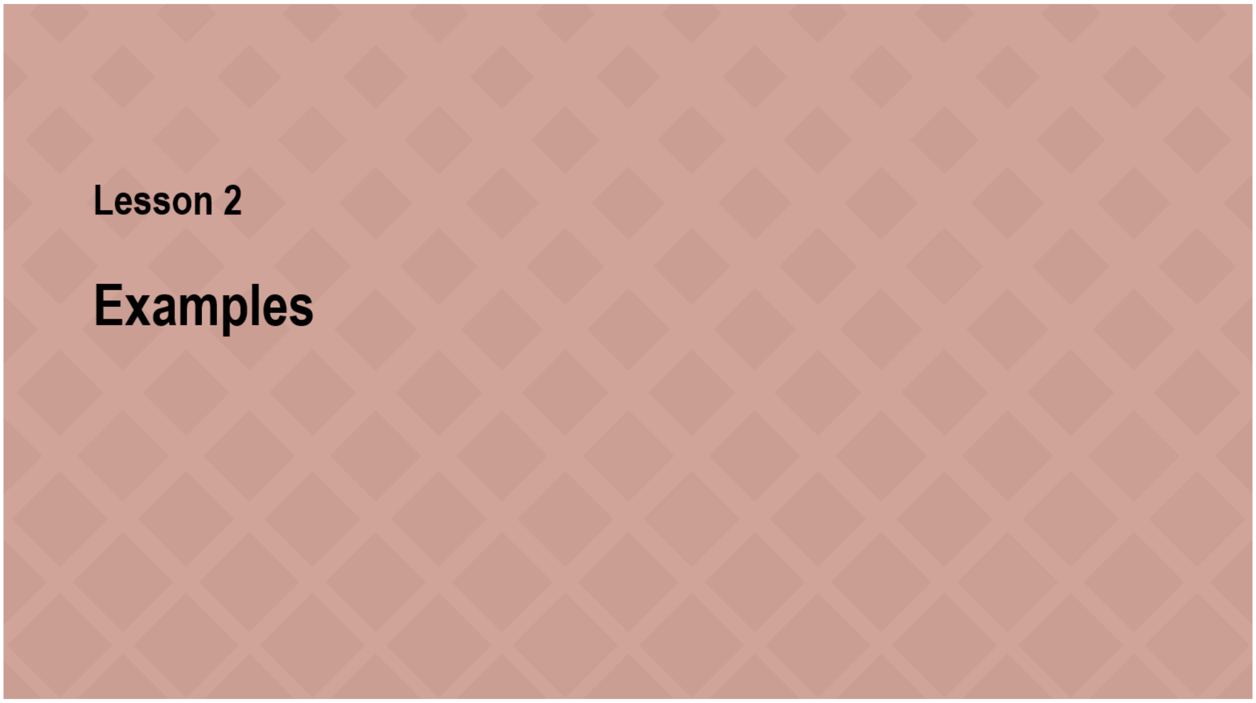
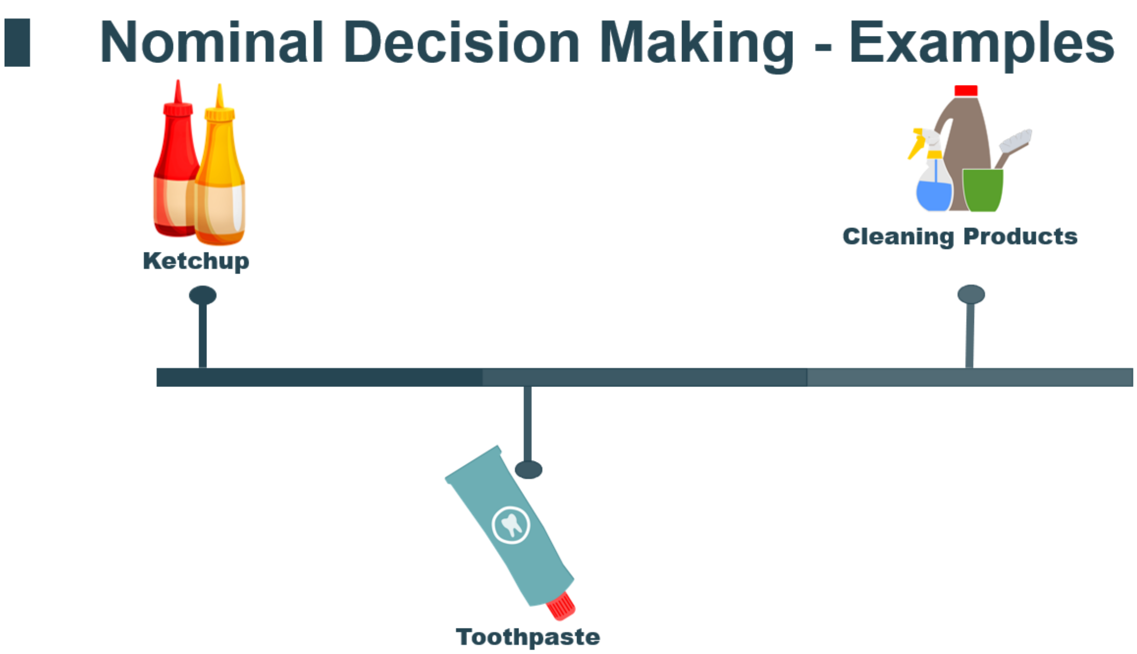
[Active segmenting break]





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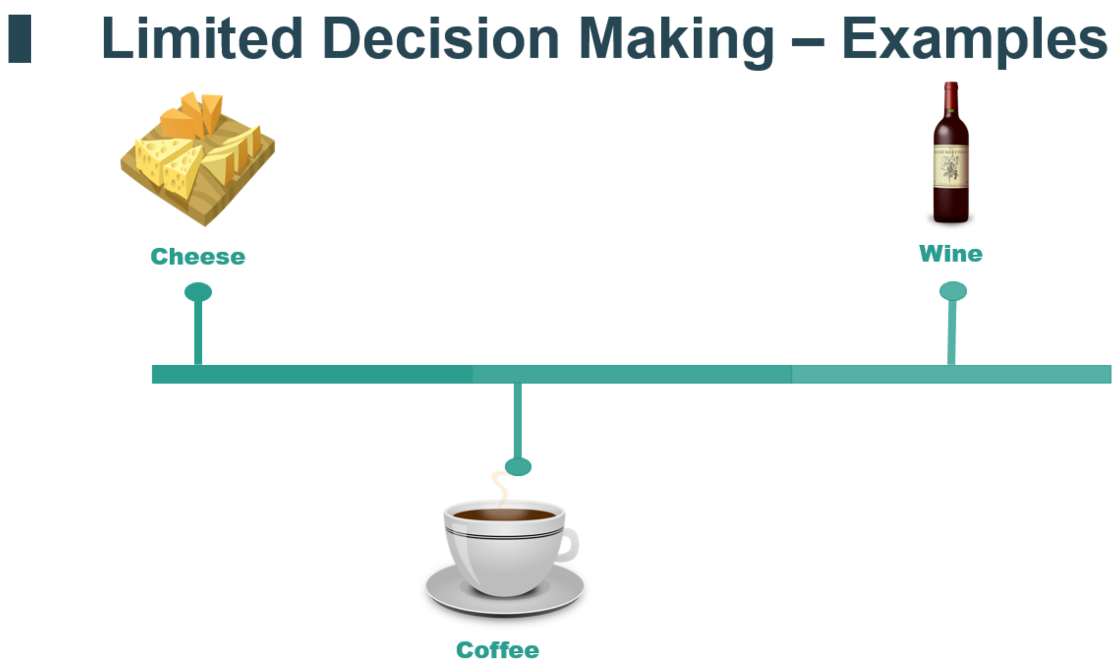
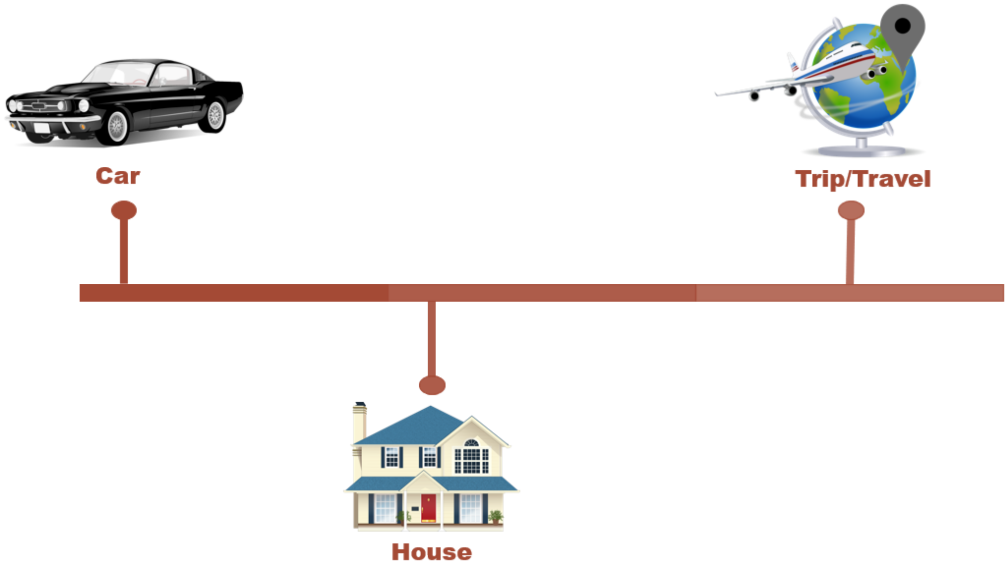


Narration: The first example of limited decision making that was talked about is cheese. You know Tillamook is good and the individually wrapped slices are bad. You make a decision at the store based off of a do not buy decision rule. Another example is coffee. Maybe you go to the store and buy the cheapest brand of coffee. You may not buy wine with your dinner because of who you have invited over.

[Passive segmenting break]

Extended Decision Making – Examples



Narration: Emotional decisions may involve extensive cognitive effort. The first example of extended decision making that was talked about is purchasing a car. You consider a variety of different makes and models of cars, compare and evaluate their attributes, and make a complex decision about which car to buy. Another example is buying a home. Homes are a long-term investment, with different attributes and alternatives. Not every house will check all of the boxes, so you must evaluate which attributes are most important to you because making the decision.

A consumer may be contemplating a decision to take a trip. There is an unlimited number of places to go, a variety of different attributes that are considered when planning a trip. Are you going to visit your parents or go to a relaxing destination? Do you want to travel abroad or stay in the United States? Mountains or beak? Tourist attractions? Time of year? Costs? Fly or drive?

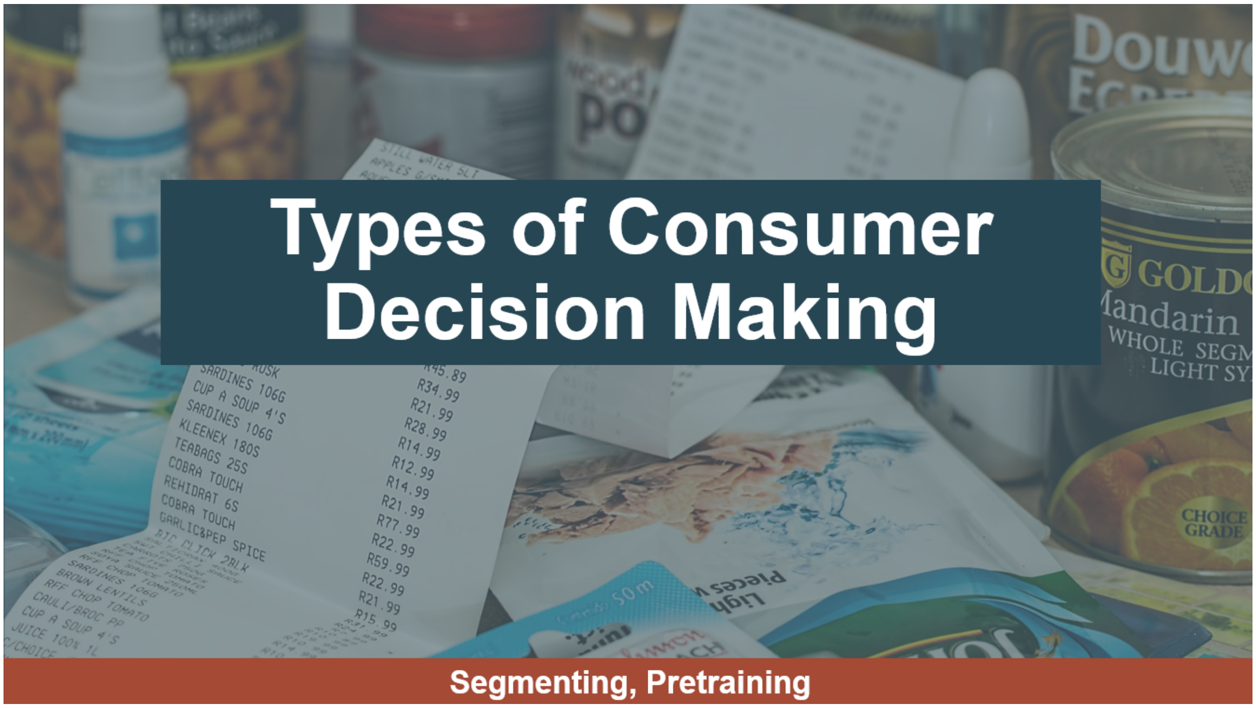
Summary

Type	Decision Making Process				
	Problem Recognition	Information Search	Alternative Evaluation	Purchase	Post Purchase
Nominal	Selective	Limited internal	None	Low involvement	• No dissonance • Very limited evaluation
Limited	Generic	• Internal • Limited external	• Few attributes • Simple decision rules • Few alternatives	Medium involvement	• No dissonance • Limited evaluation
Extended	Generic	• Internal • External	• Many attributes • Complex decisions rules • Many alternatives	High involvement	• Dissonance • Complex evaluation

Narration: To wrap up, problem recognition can be selective or generic. Information searches can consist of internal and/or external searches. For higher involvement, attributes, decision rules, and alternatives are considered. Purchases range from low to high involvement and may consist of post purchase dissonance and evaluation. Nominal decision making is the lowest level of purchase involvement and extended decision making is the highest.

[Active segment break]

PSM Treatment



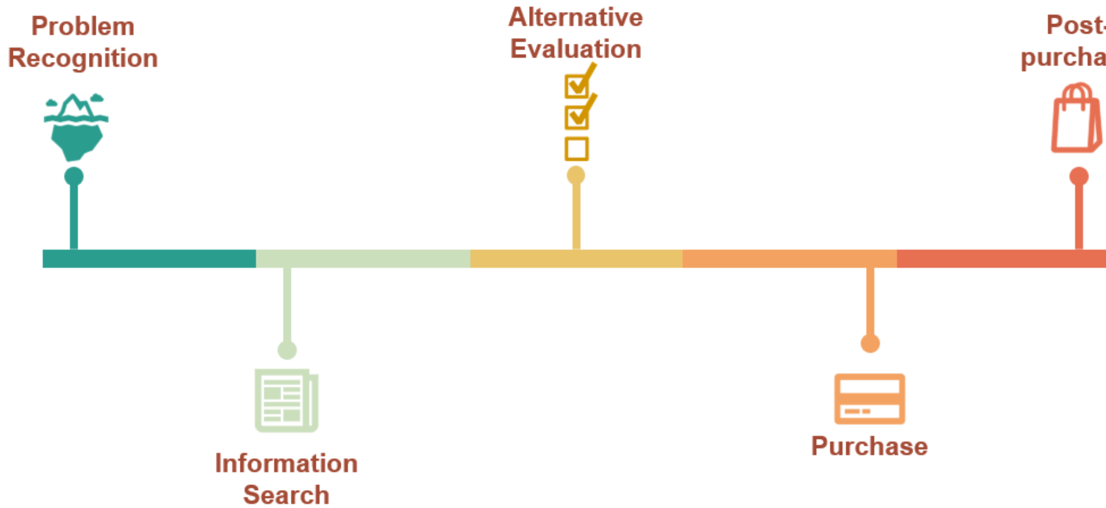
Lesson 1

Overview – The Consumer Decision Process

3 Types of Consumer Decision Making

Narration: There are three types of decisions that consumers make: nominal, limited, and extended. According to Mothersbaugh & Hawkins (2016), purchase involvement is “The level of concern for, or interest in, the process triggered by the need to consider a particular purchase” (p. 450-451).

Consumer Decision Making Process



Narration: When making a purchase, the consumer decision making process consists of five steps. These five steps include problem recognition, information search, alternative evaluation, purchase, and post purchase. Nominal decision making only consists of four of the five steps, as nominal decision making doesn't include an alternative evaluation.

[Passive segment break]

The Decision Making Process

Type	Decision Making Process				
	Problem Recognition	Information Search	Alternative Evaluation	Purchase	Post Purchase
Nominal	Selective	Limited internal	None	Low involvement	• No dissonance • Very limited evaluation
Limited	Generic	• Internal • Limited external	• Few attributes • Simple decision rules • Few alternatives	Medium involvement	• No dissonance • Limited evaluation
Extended	Generic	• Internal • External	• Many attributes • Complex decisions rules • Many alternatives	High involvement	• Dissonance • Complex evaluation

Narration: Nominal decisions involve selective problem recognition, meaning one brand can solve the consumer's problem. A problem is recognized when a consumer perceives a discrepancy between their actual state and desired state. Actual state is the way an individual perceives his or her feelings at the current moment. Desired state is what an individual wants to feel or be at the current moment.

Nominal decision making is habitual decision making. It involves no decision. A limited internal information search is conducted and a purchase is made. This purchase is either brand loyal or repeat. A brand loyal purchase means there's a brand you are committed to because it meets your needs. A repeat purchase is a product purchased over and over again without much importance place on anything but the product itself. After the purchase there is no dissonance and very little evaluation.

Limited decisions involve generic problem recognition, meaning more than one brand can solve the consumer's problem. An internal and limited external information search is conducted. Few attributes and alternatives are considered and simple decision rules are used. The purchase is made and there is little dissonance or evaluation post purchase.

Extended decisions involve generic problem recognition and an extensive internal and external information search. Many attributes and alternatives are considered and complex decision rules are used. The purchase is made. Dissonance is felt and a complex evaluation is conducted post purchase. Extended decisions involve generic problem recognition and an extensive internal and external information search. Many attributes and alternatives are considered and complex decision rules are used. The purchase is made, dissonance is felt, and a complex evaluation is conducted post purchase.

[Active segment break]

Lesson 2

Types of Decision Making

Problem Recognition

Narration: The first step in the consumer decision making process is problem recognition. The consumer recognizes that they need to acquire something (i.e., make a purchase) to get them to their desired state. A need can arise when a consumer recognized an emotional or situational need. Once the consumer has recognized a problem, they move onto the information search.

Information Search

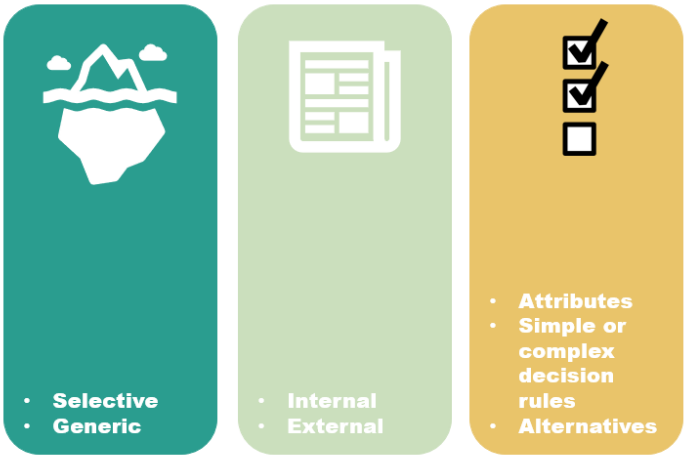
Narration: The information search in nominal decision making is limited internal. This search is conducted by retrieving information from long-term memory to provide a single solution. An example of this is running out of ketchup. You always buy Heinz so you'll buy Heinz again. You recognized a problem between your actual state (no ketchup) and desired state (having ketchup) so you retrieve information from your long-term memory (I like Heinz ketchup).

The information search in limited decision making is internal, with a limited external search. This search is conducted by retrieving information from long-term memory as well as considering a very limited examination of other options. For example, you need to purchase cheese. You remember that Tillamook cheese is good and you don't like the individually wrapped cheese slices. You have a very limited examination of a "do not buy" option. You may also go to the store and purchase the cheapest brand of cheese. You may choose to ask a friend or family member their favorite brand or recall a commercial you saw on TV last night.

Extended decision making involves an extensive internal and external search. The consumer relies on internal information has been both actively and passively acquired through past searches, personal experiences, and low-involvement learning as well as external information, such as independent groups, personal contacts, marketing information, and experience.

[Passive segment break]

Alternative Evaluation

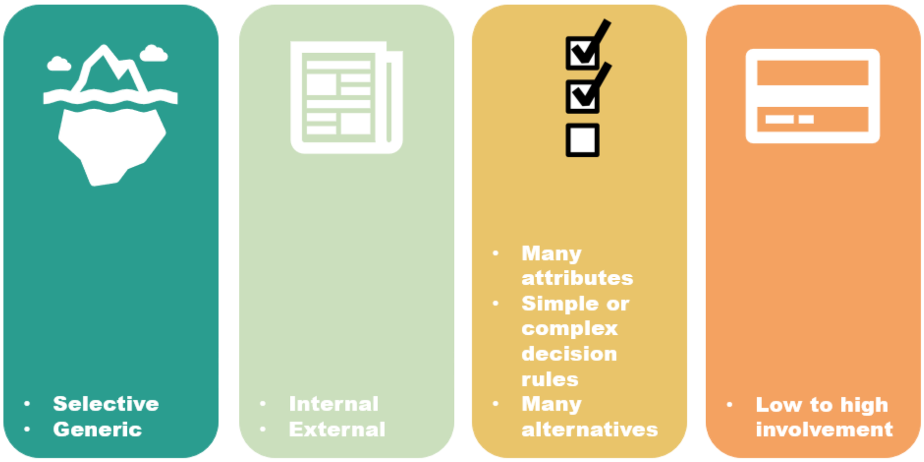


Narration: Nominal decision making does not include alternative evaluation because there is no decision involved. Think back to the ketchup example, you purchase Heinz ketchup without considering alternative brands, products, or attributes. Limited decision making involves few attributes and alternatives and simple decision rules. You may only consider one or two desirable features/characteristics. You may have a decision rule that you buy the new brand or product because you are bored with the current, satisfactory brand or you buy the cheapest brand of an item available. Only a few alternatives are considered. At the grocery store down the cheese aisle, you may consider Tillamook and Kroger cheese.

In extended decision making, once the information search has been completed, the consumer performs a complex evaluation of many attributes and alternatives and complex decision rules. An example is buying a car. There are many attributes and alternatives you are considered, like year, miles, maybe brand/manufacturer, features, and so on. You may use complex decision rules and establish minimum performance standards for evaluative criterion and select brands that meet or exceed those expectations. You may also establish a minimum level of performance for each important attributes and then select brands that meet or exceed those expectations on any attribute. You may rank the evaluative criterion in order of importance and establish a cut off point.

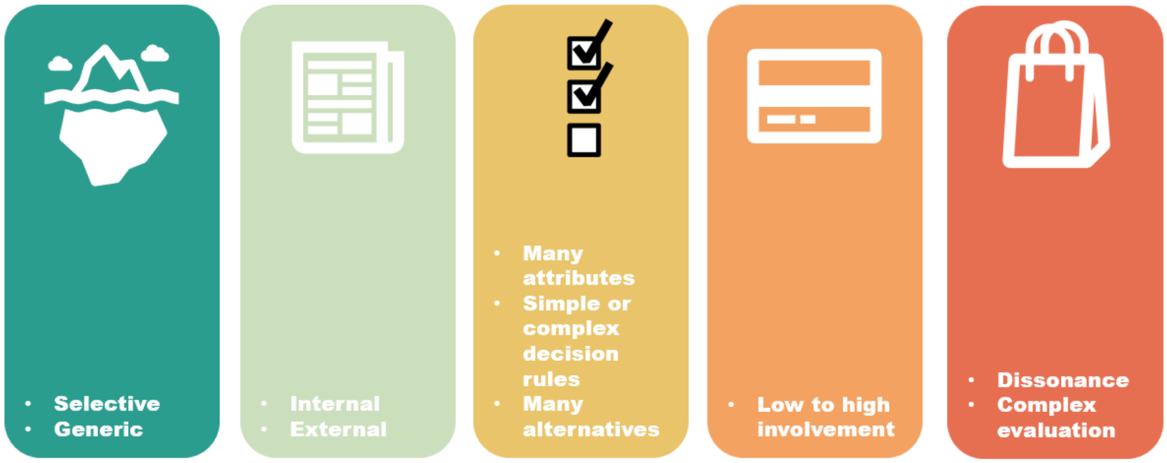
[Passive segment break]

Purchase



Narration: Nominal decision making is a low-involvement purchase because there's little to no decision involvement. A decision that is completely nominal does not consider alternatives to purchase. Limited decision making in its simplest form is very similar to nominal decision making. It falls in the middle of nominal and extended decision making. There is still low purchase involvement and little effort is involved in making the purchase decision. Extended decision making is the highest level of purchase involvement. The consumer may spend hours, days, or even weeks considering the problem, the information they have found, and their alternative evaluation.

Post Purchase



Narration: In nominal decision making, once the purchase has been made, there is no dissonance. The consumers need has been met and they have reached their desired state. Evaluation rarely takes place and is only conducted if the purchase fails to meet expectations. In limited decision making, once the purchase has been made, there is no dissonance. The consumers need has been met and they have reached their desired state. The purchase and use of the product is given little evaluation unless the product has a problem or failed to meet expectations. In extended decision making, after the purchase, doubt and guilt are likely. A thorough evaluation takes place. The consumer often rates the satisfaction to each of their evaluative criterion. Satisfaction and dissatisfaction is dissatisfied responses are likely if the consumer is dissatisfied with the purchase.

[Active segment break]

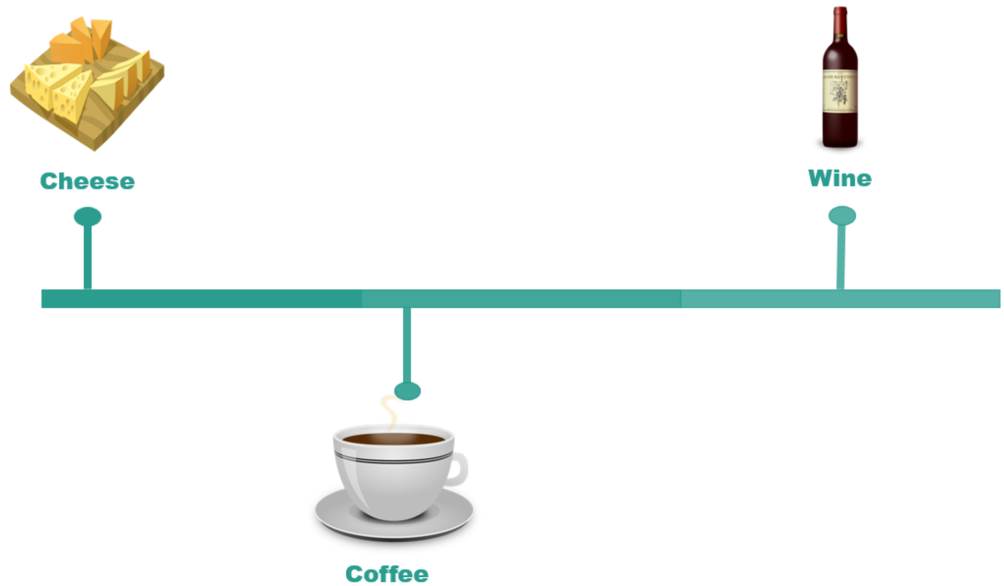
Lesson 3

Examples

Nominal Decision Making - Examples

Narration: The first example of nominal decision making that was talked about is ketchup. Another example is toothpaste. One morning you realize you're about out of toothpaste. You add toothpaste to your grocery list and a few days later, you're in the store and look for Colgate without comparing price, ingredients, or alternative brands. Another example is cleaning products. You know what works and what doesn't work. When you need to purchase new cleaning products, you buy what you always buy. You most likely don't buy a new type of dish soap every time you run out.

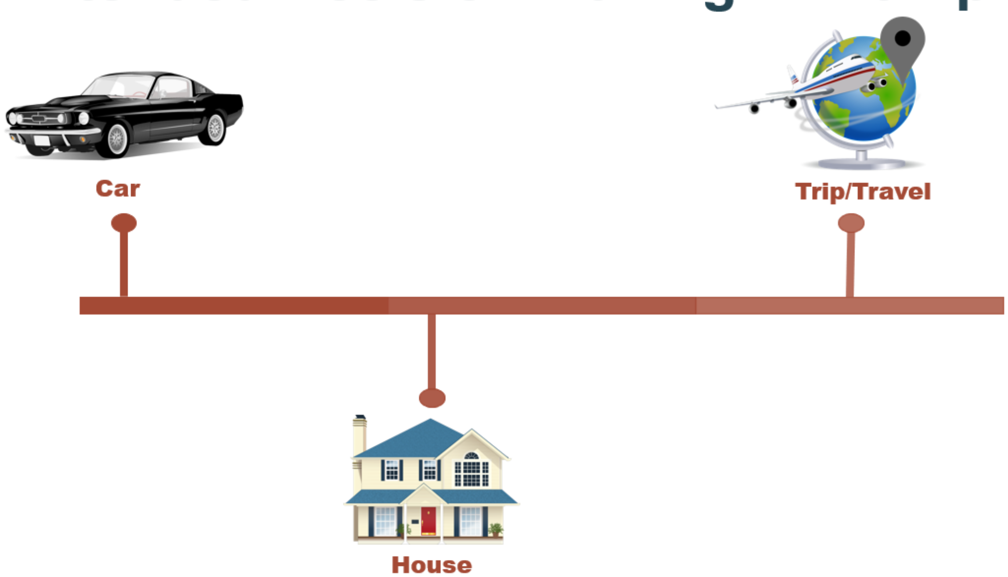
Limited Decision Making – Examples



Narration: The first example of limited decision making that was talked about is cheese. You know Tillamook is good and the individually wrapped slices are bad. You make a decision at the store based off of a do not buy decision rule. Another example is coffee. Maybe you go to the store and buy the cheapest brand of coffee. You may not buy wine with your dinner because of who you have invited over.

[Passive segmenting break]

Extended Decision Making – Examples



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Summary

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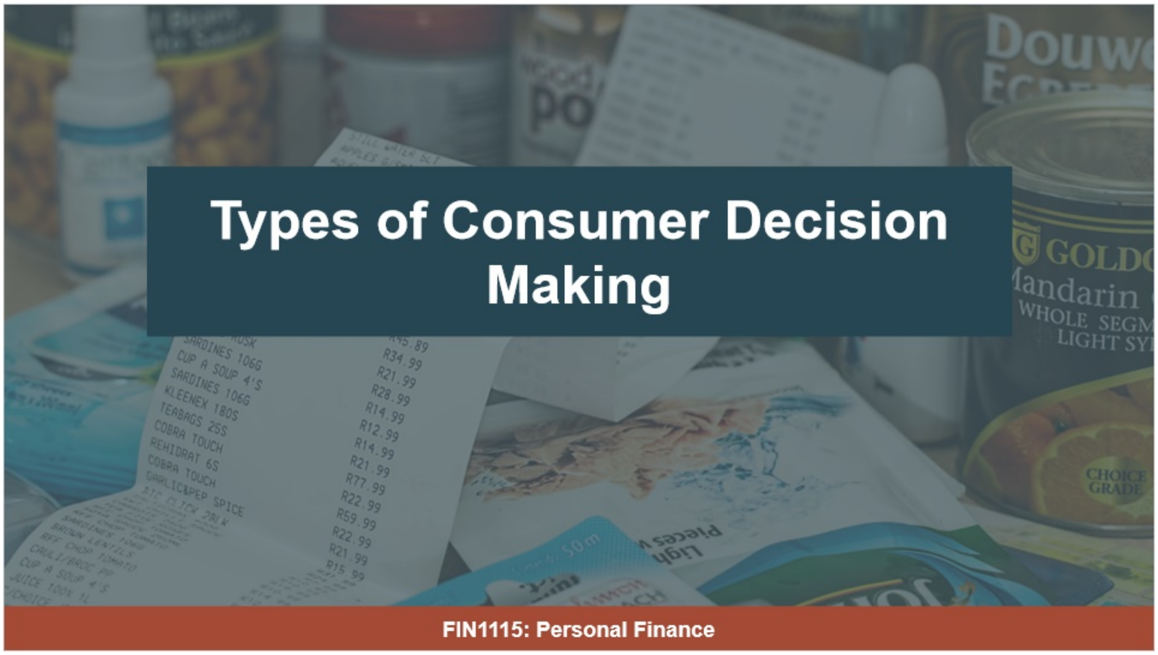
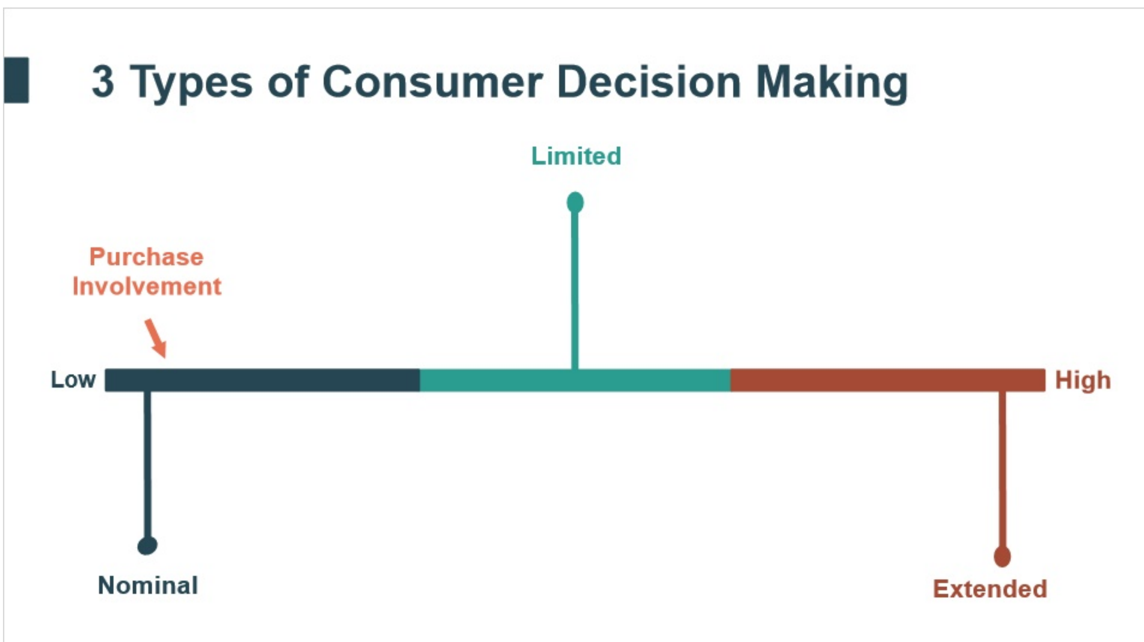
[Active segmenting break]

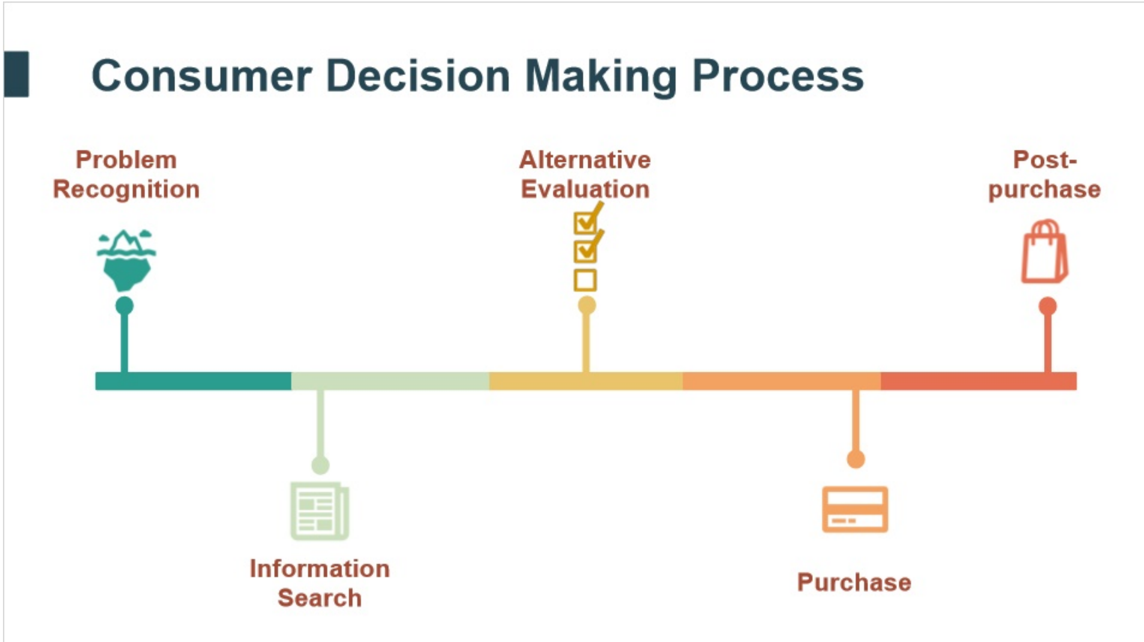
APPENDIX I

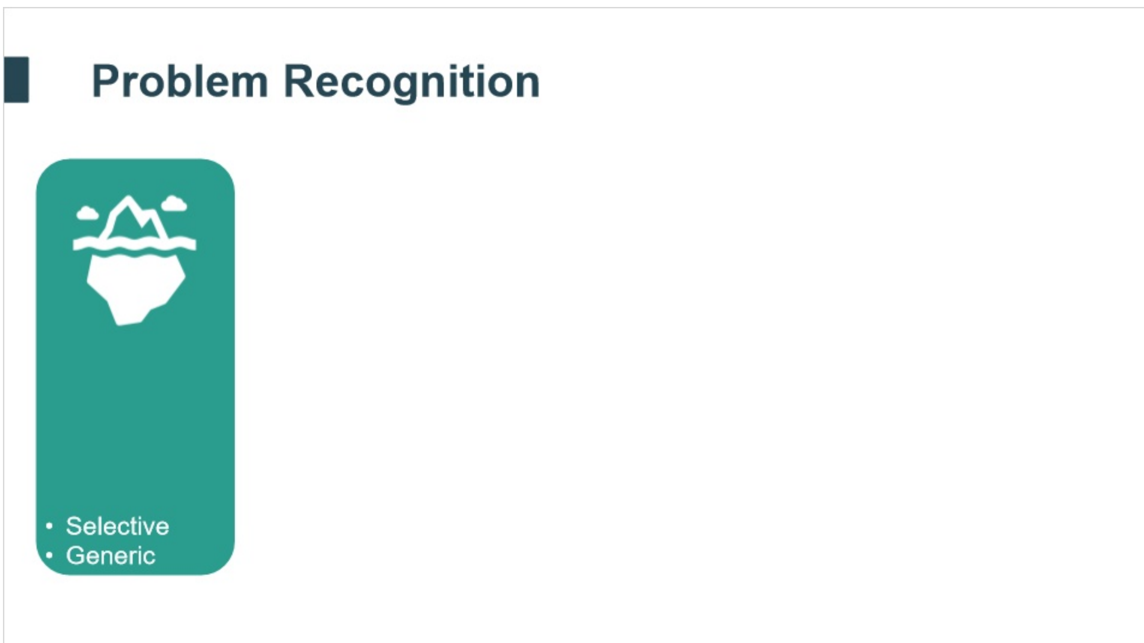
Treatments (Storyline Slides)

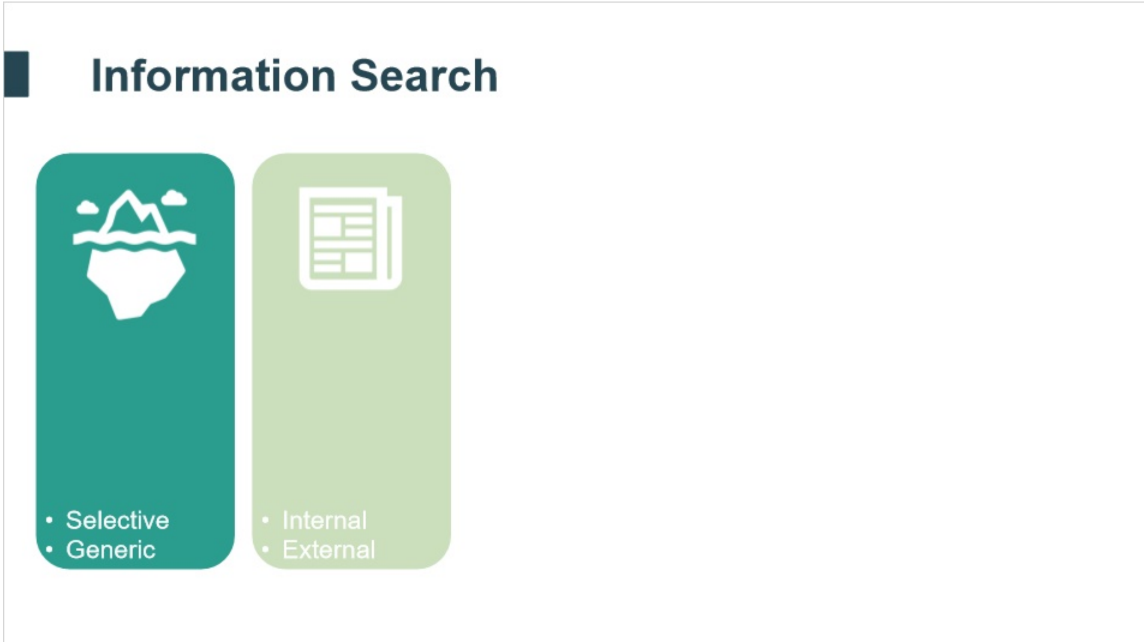
No Segmenting – No Pretraining (M Treatment)

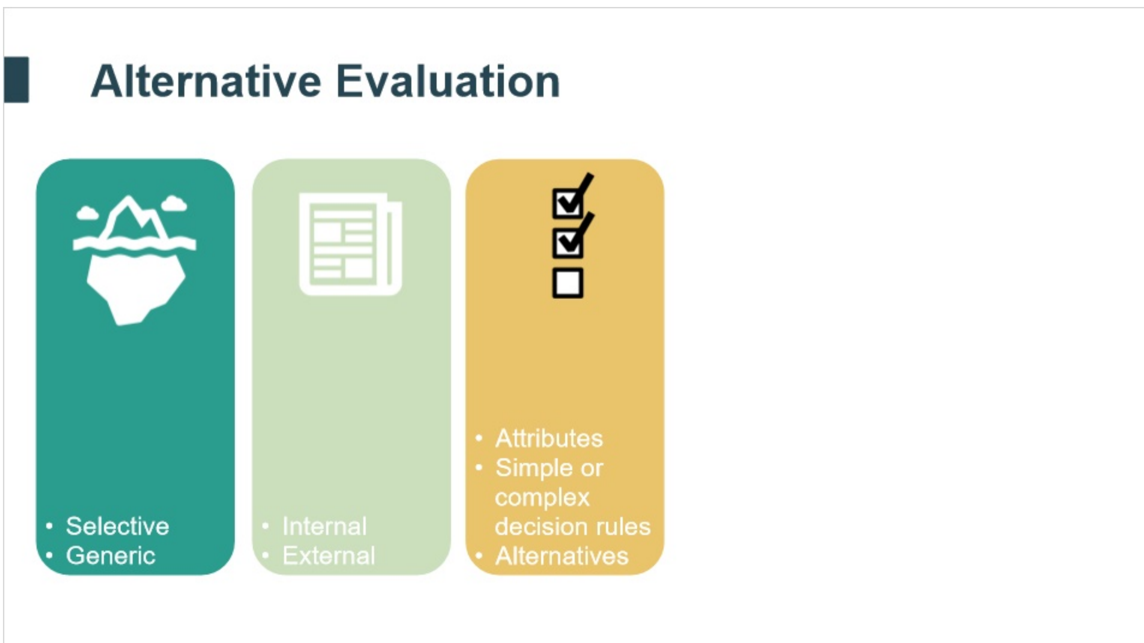





Consumer Decision Making Process
Problem Recognition
Alternative Evaluation
Post-purchase
Information Search
Purchase


Problem Recognition
Selective
Generic


Information Search
• Selective
• Generic
• Internal
• External


Alternative Evaluation
• Selective
• Generic
• Internal
• External
• Attributes
• Simple or complex decision rules
• Alternatives

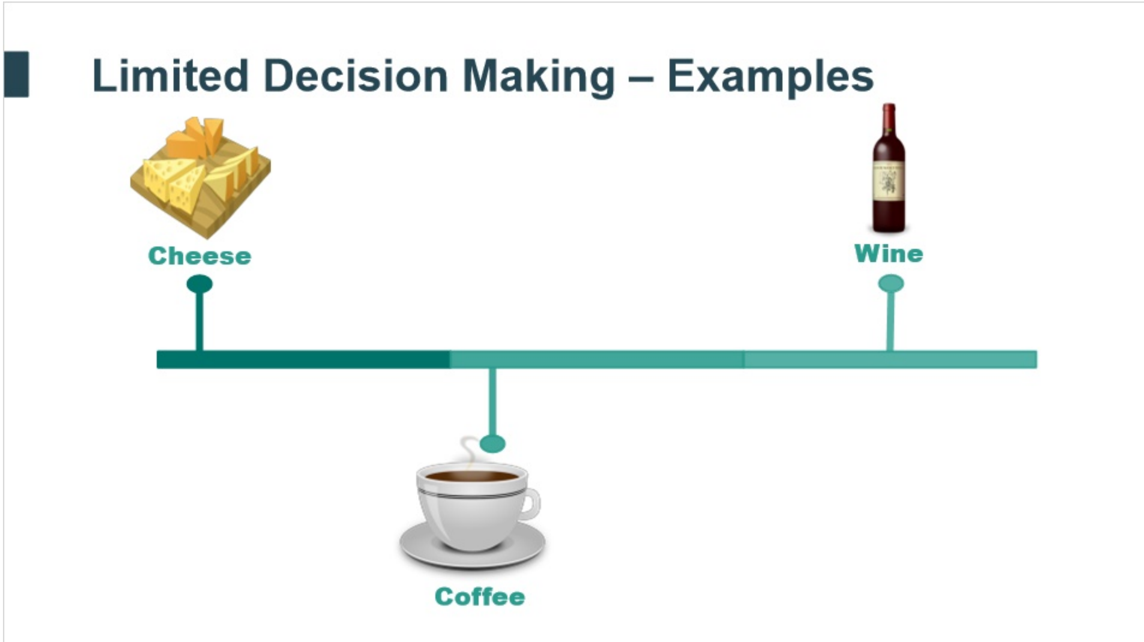

Purchase
Selective
Generic
Internal
External
Many attributes
Simple or complex decision rules
Many alternatives
Low to high involvement

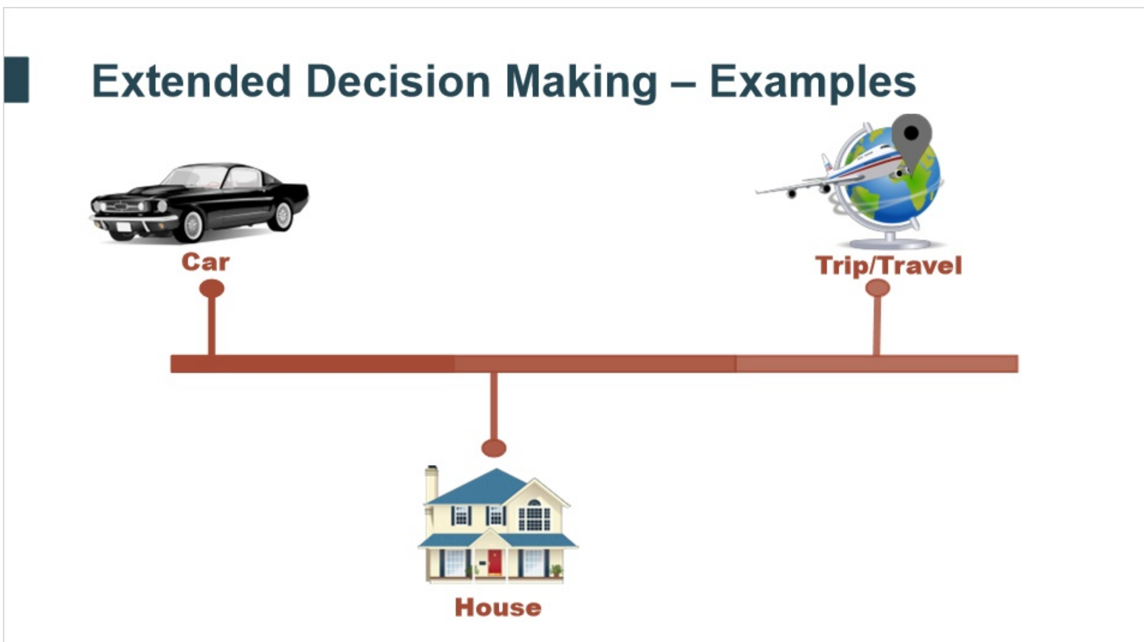

Post Purchase
Selective
Generic
Internal
External
Many attributes
Simple or complex decision rules
Many alternatives
Low to high involvement
Dissonance
Complex evaluation

The Decision Making Process

Type	Decision Making Process				
	Problem Recognition	Information Search	Alternative Evaluation	Purchase	Post Purchase
Nominal	Selective	Limited internal	None	Low involvement	• No dissonance • Very limited evaluation

Nominal Decision Making - Examples


Limited Decision Making – Examples
Cheese
Wine
Coffee


Extended Decision Making – Examples
Car
Trip/Travel
House

Summary

Type	Decision Making Process				
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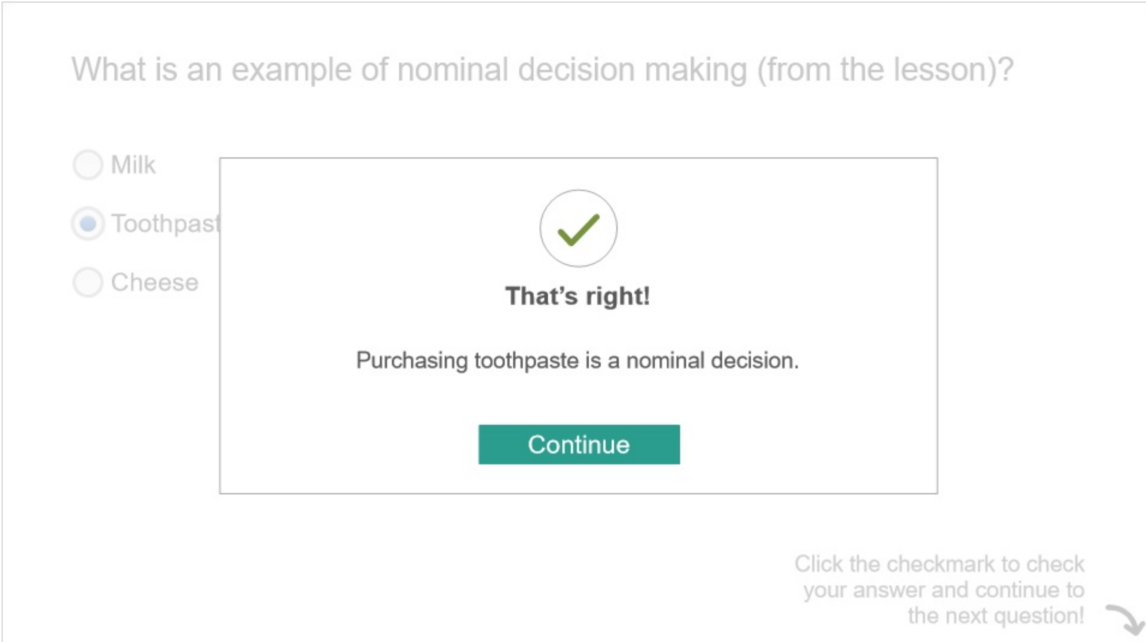
Review Question 1
(Multiple Choice, 1 attempt permitted)

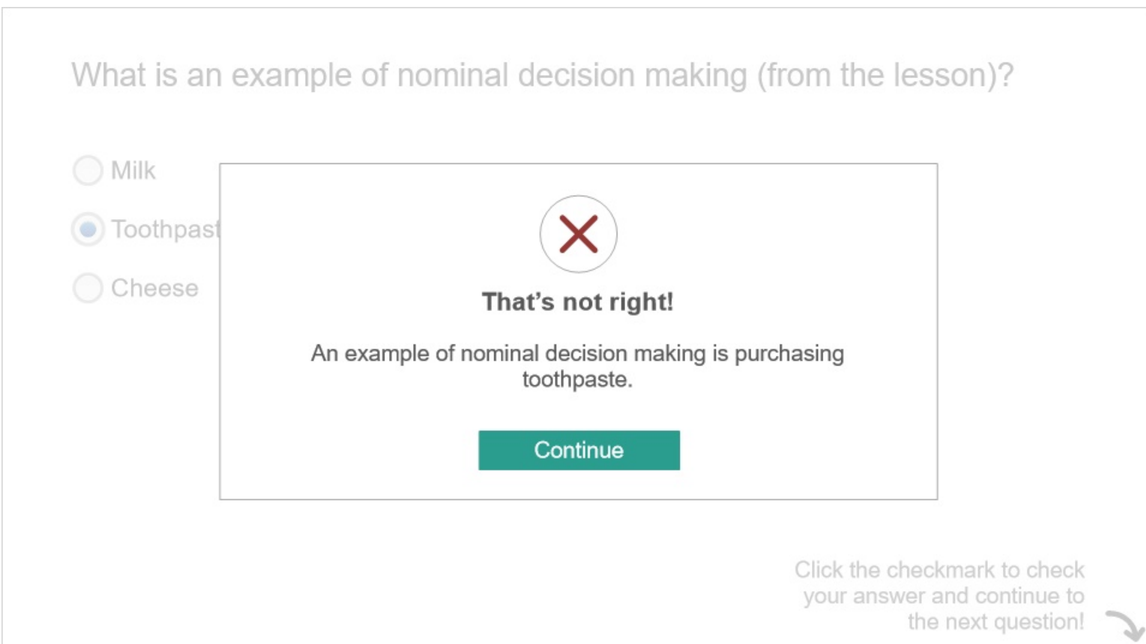
What is an example of nominal decision making (from the lesson)?

- Milk
- Toothpaste
- Cheese

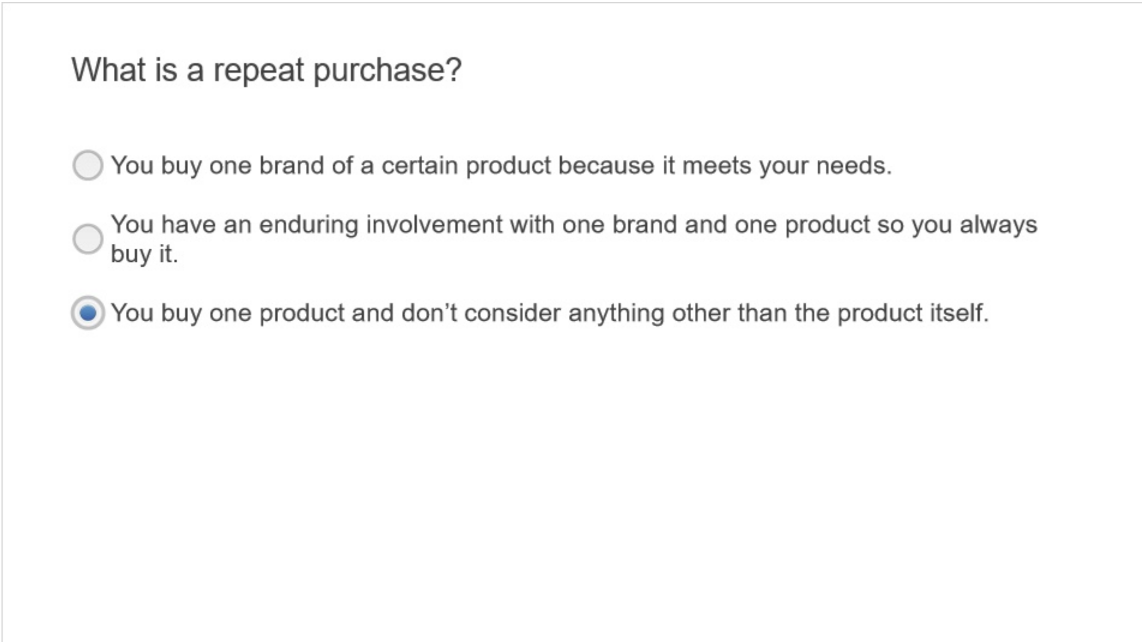
Click the checkmark to check your answer and continue to the next question!

Correct	Choice
	Milk
X	Toothpaste
	Cheese

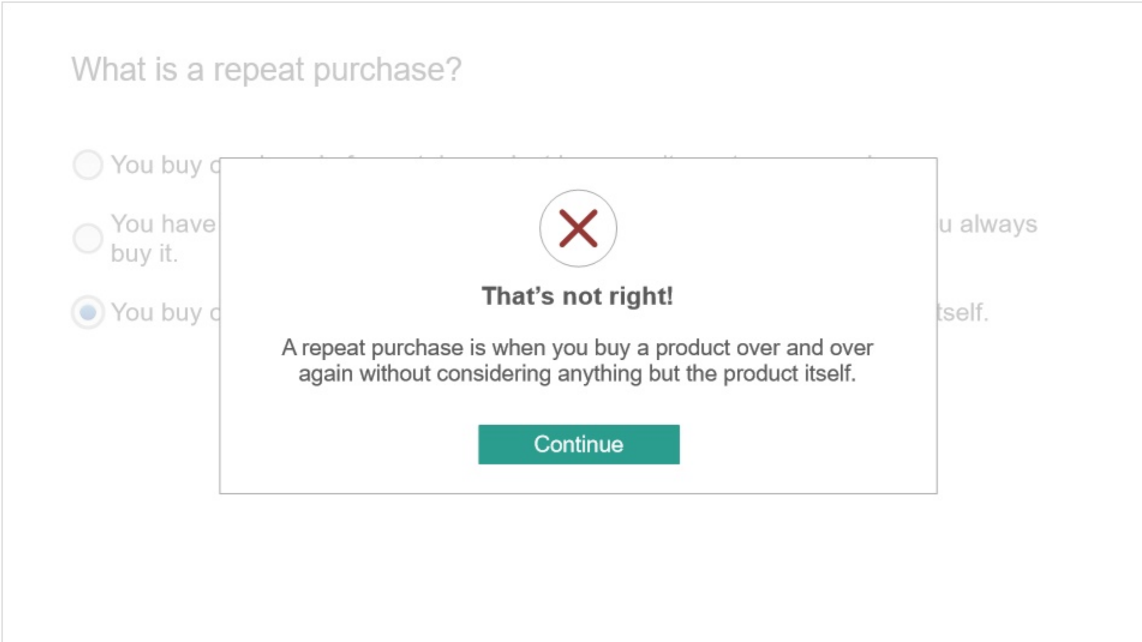

What is an example of nominal decision making (from the lesson)?
Milk
Toothpast
Cheese
That's right!
Purchasing toothpaste is a nominal decision.
Continue
Click the checkmark to check your answer and continue to the next question!

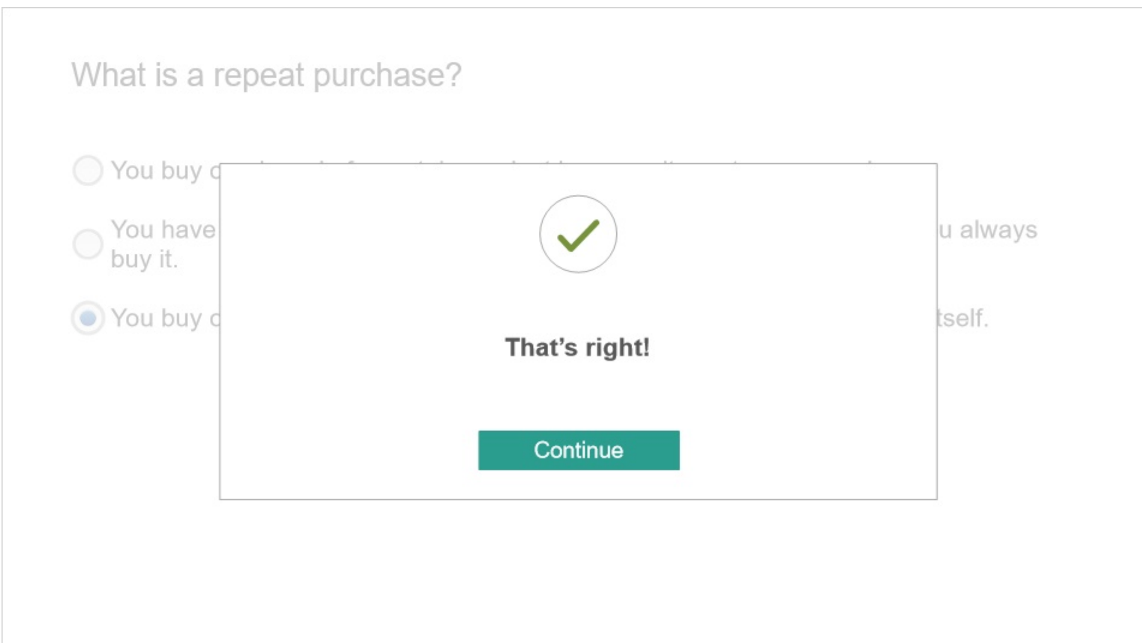

What is an example of nominal decision making (from the lesson)?
Milk
Toothpast
Cheese
That's not right!
An example of nominal decision making is purchasing toothpaste.
Continue
Click the checkmark to check your answer and continue to the next question!

Review Question 2
(Multiple Choice, 1 attempt permitted)



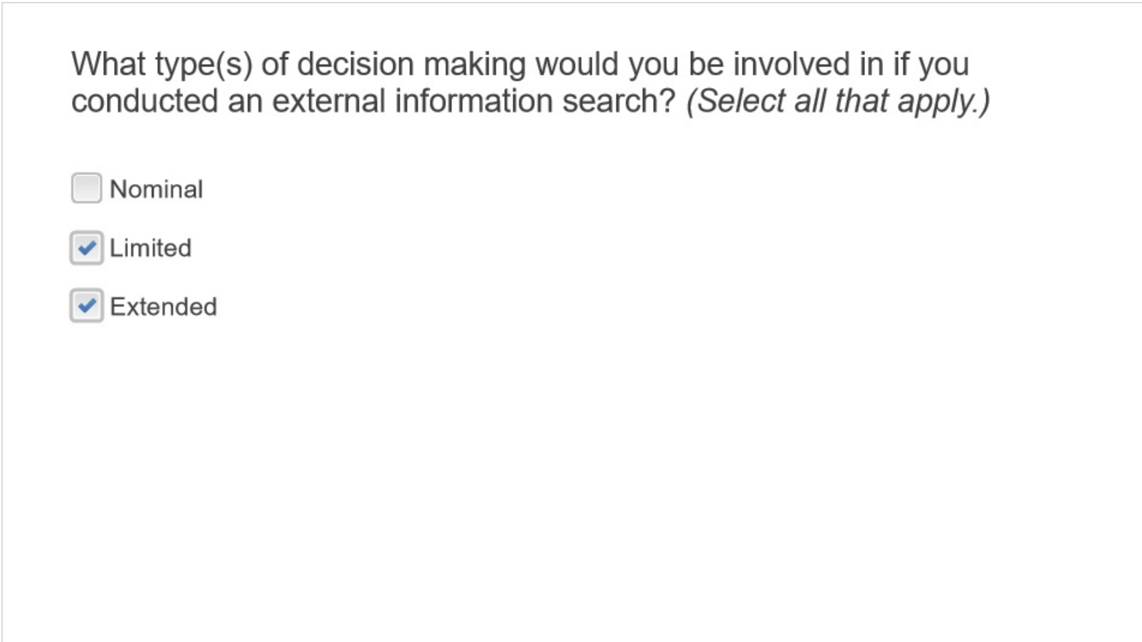
Correct	Choice
	You buy one brand of a certain product because it meets your needs.
	You have an enduring involvement with one brand and one product so you always buy it.
X	You buy one product and don’t consider anything other than the product itself.


What is a repeat purchase?
You buy c
You have
u always
buy it.
You buy c
tself.
That's not right!
A repeat purchase is when you buy a product over and over again without considering anything but the product itself.
Continue

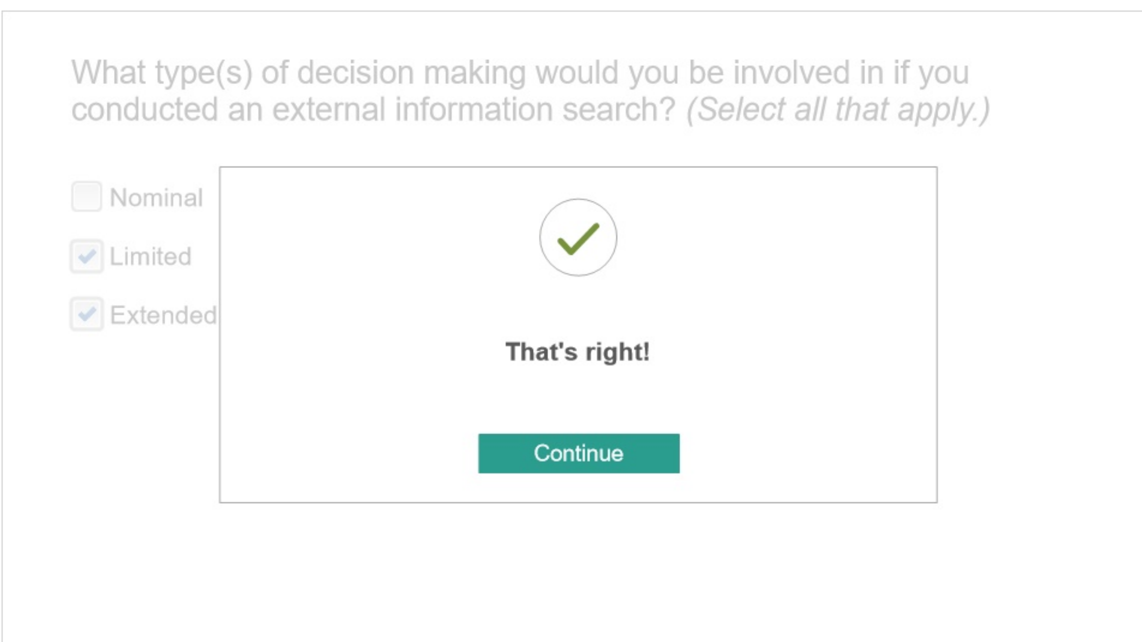

What is a repeat purchase?
You buy c
You have
u always
buy it.
You buy c
tself.
That's right!
Continue

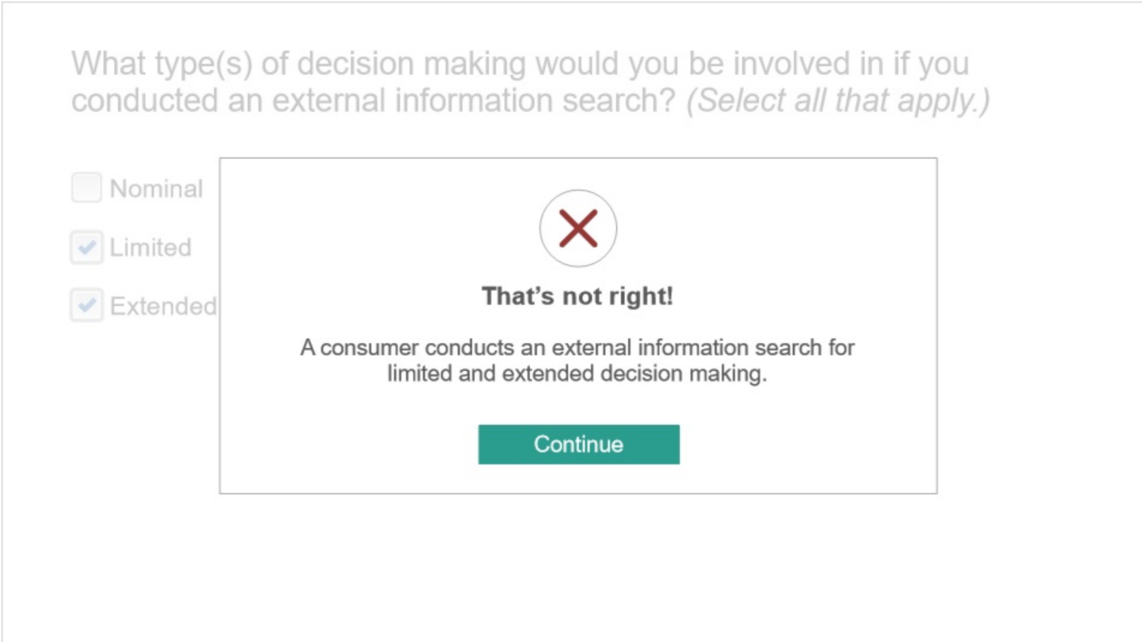
Review Question 3

(Multiple Response, 1 attempt permitted)

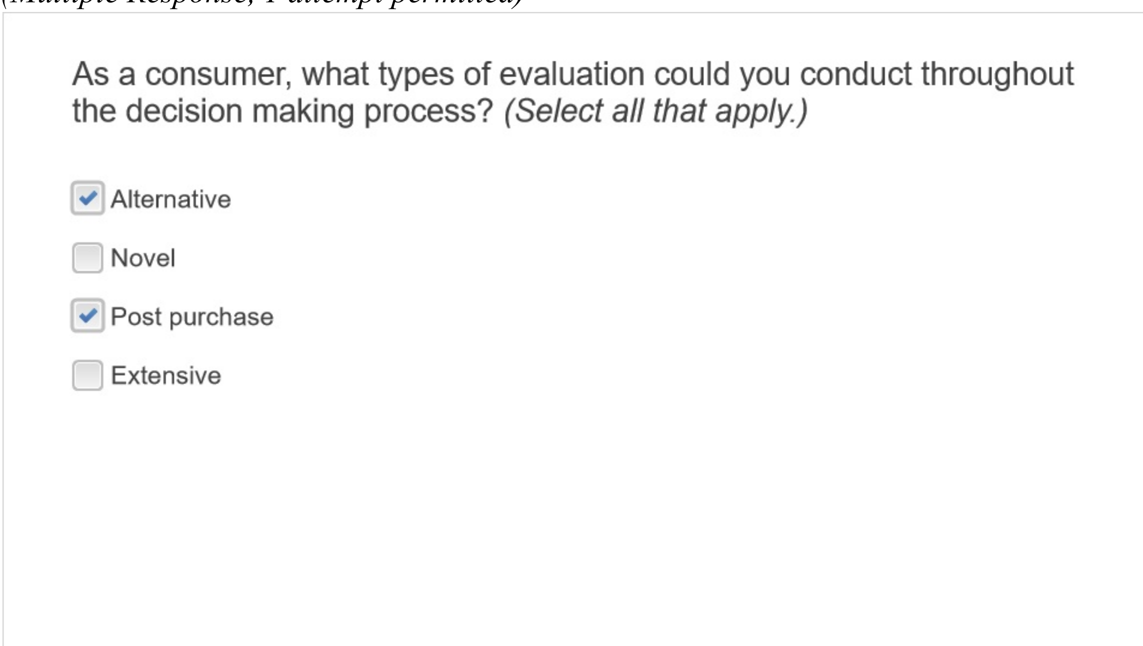


Correct	Choice
	Nominal
X	Limited
X	Extended

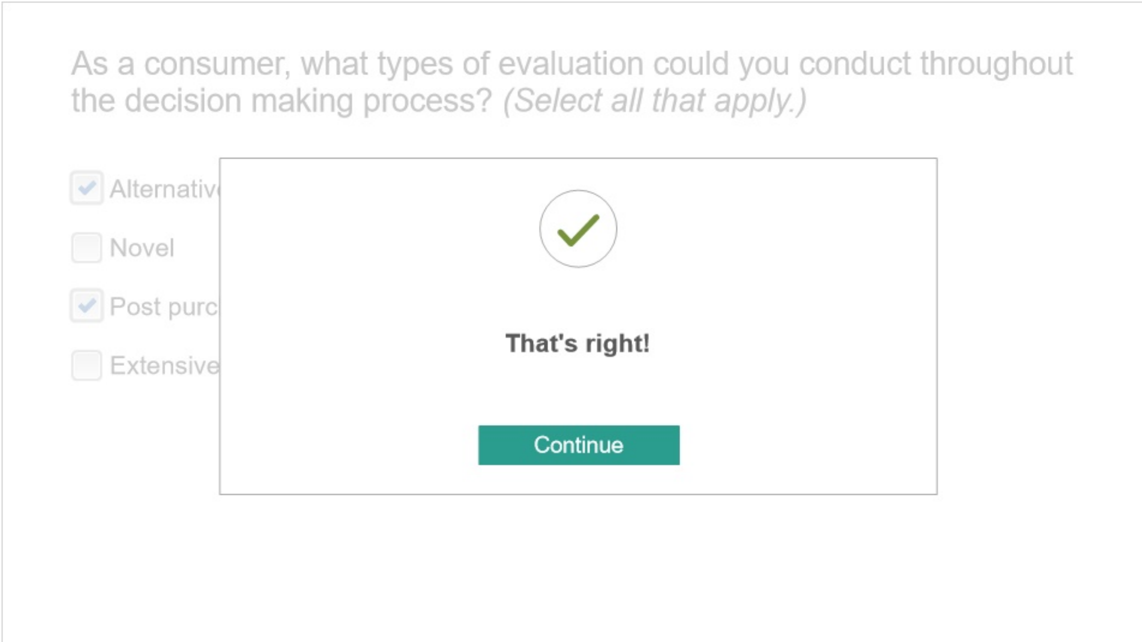


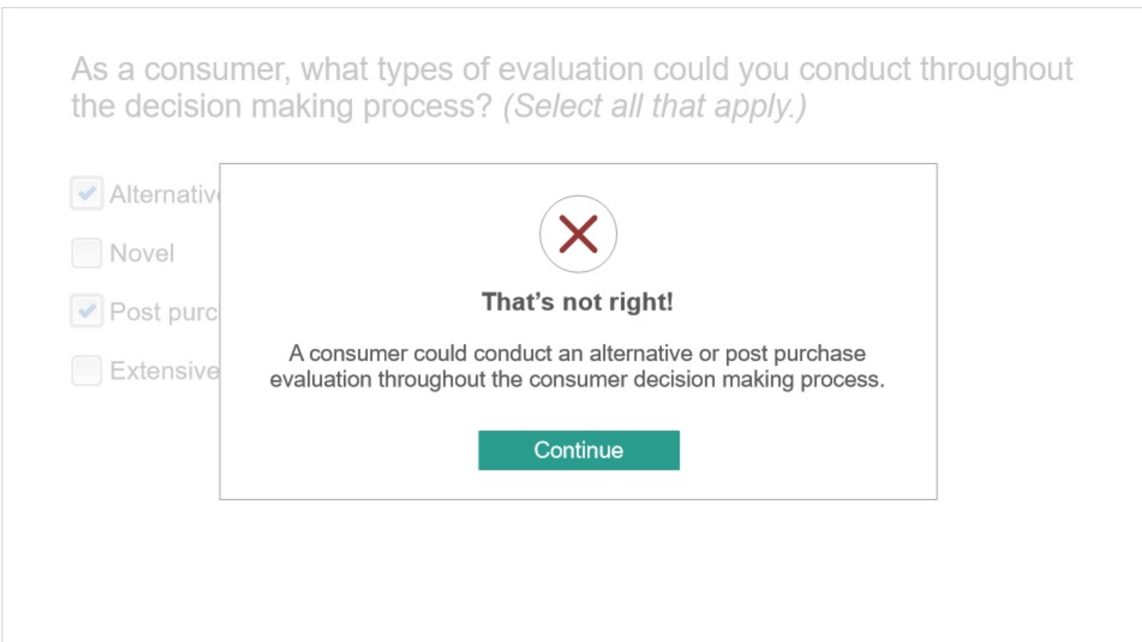


Review Question 4
(Multiple Response, 1 attempt permitted)



Correct	Choice
X	Alternative
	Novel
X	Post purchase
	Extensive


As a consumer, what types of evaluation could you conduct throughout the decision making process? *(Select all that apply.)*
Alternativ
Novel
Post purc
Extensive
That's right!
Continue

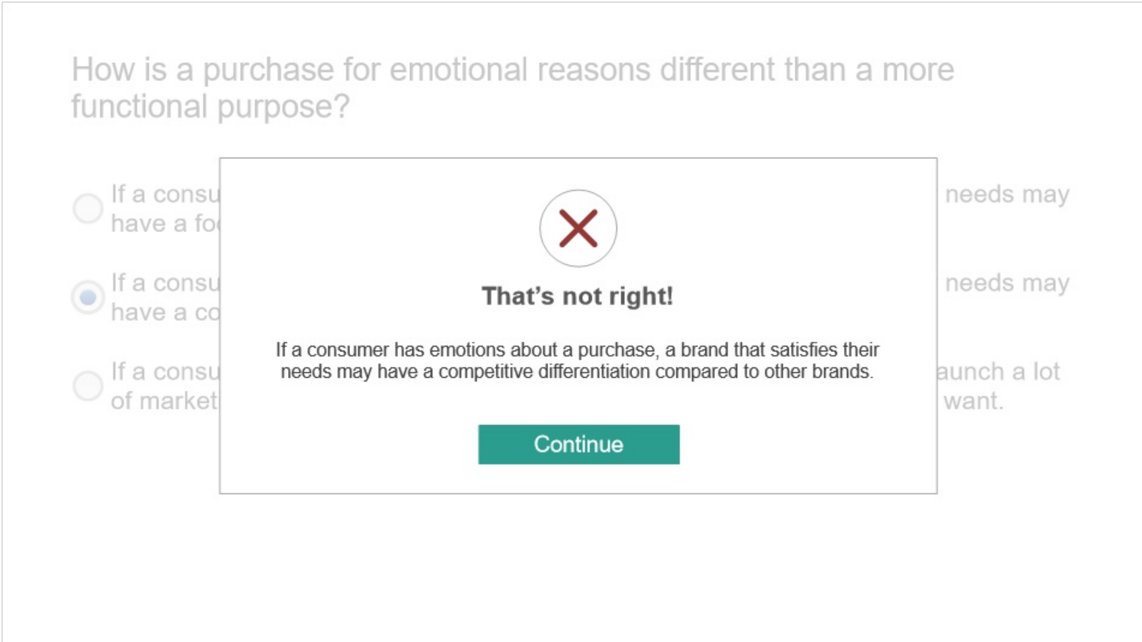

As a consumer, what types of evaluation could you conduct throughout the decision making process? *(Select all that apply.)*
Alternativ
Novel
Post purc
Extensive
That's not right!
A consumer could conduct an alternative or post purchase evaluation throughout the consumer decision making process.
Continue

Review Question 5
(Multiple Choice, 1 attempt permitted)

How is a purchase for emotional reasons different than a more functional purpose?

- If a consumer has emotions about a purchase, a brand that satisfies their needs may have a foot in the door because of product credibility.
- If a consumer has emotions about a purchase, a brand that satisfies their needs may have a competitive differentiation compared to other brands.
- If a consumer has emotions about a purchase, a brand may not need to launch a lot of marketing campaigns because the consumer already knows what they want.

Correct	Choice
	If a consumer has emotions about a purchase, a brand that satisfies their needs may have a foot in the door because of product credibility.
X	If a consumer has emotions about a purchase, a brand that satisfies their needs may have a competitive differentiation compared to other brands.
	If a consumer has emotions about a purchase, a brand may not need to launch a lot of marketing campaigns because the consumer already knows what they want.


How is a purchase for emotional reasons different than a more functional purpose?
If a consu
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needs may
If a consu
have a co
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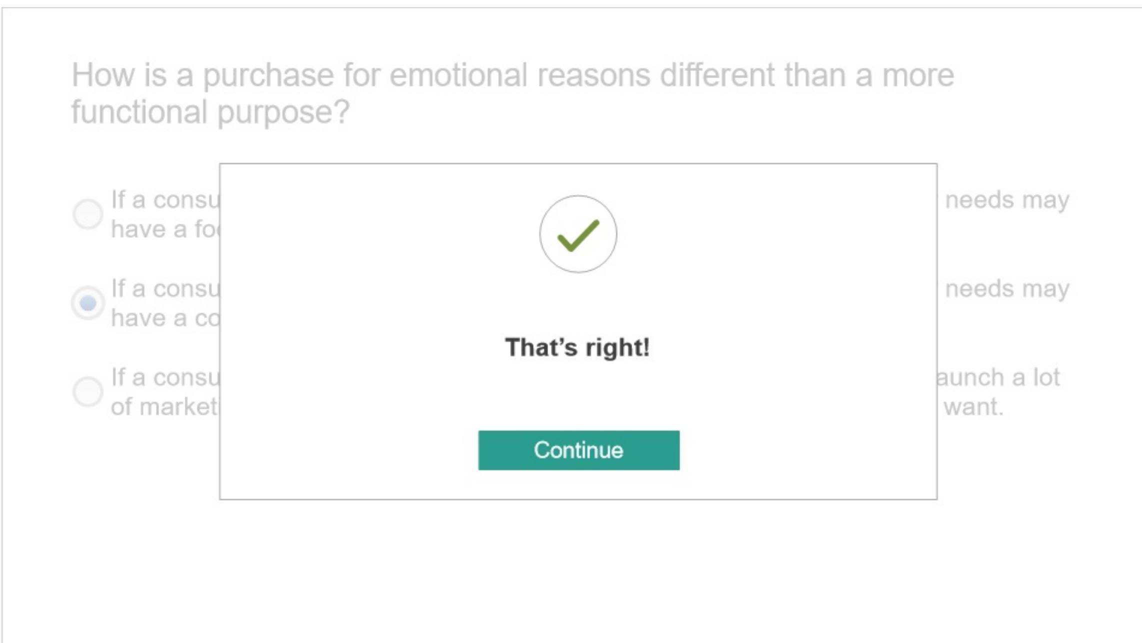
aunch a lot
want.
That’s not right!
If a consumer has emotions about a purchase, a brand that satisfies their needs may have a competitive differentiation compared to other brands.
Continue


How is a purchase for emotional reasons different than a more functional purpose?
If a consu
have a fo
needs may
If a consu
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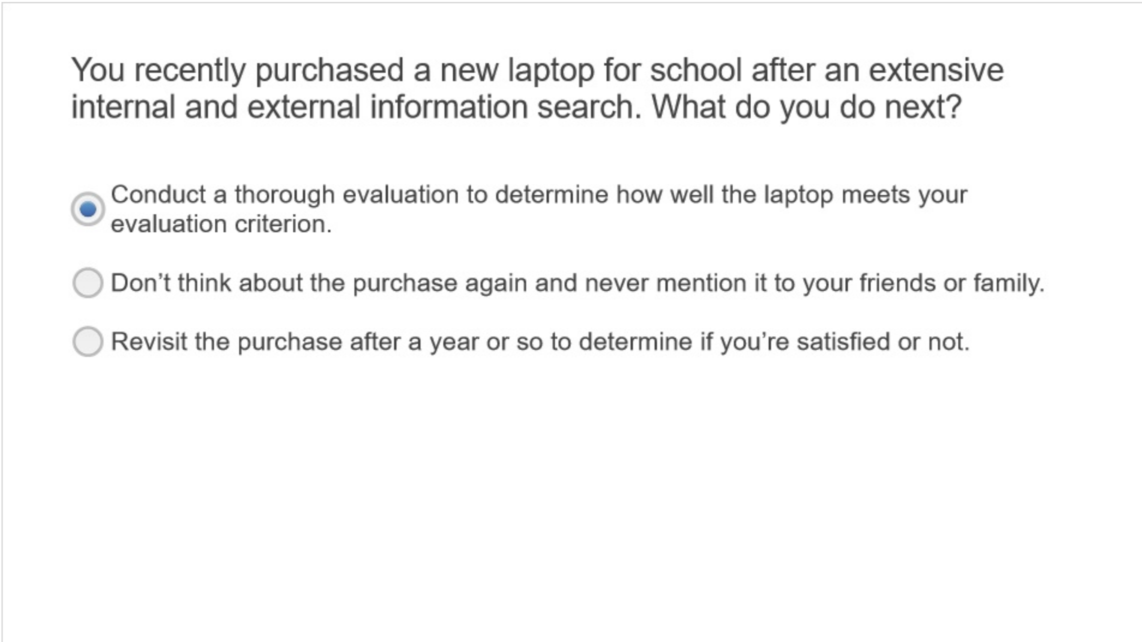
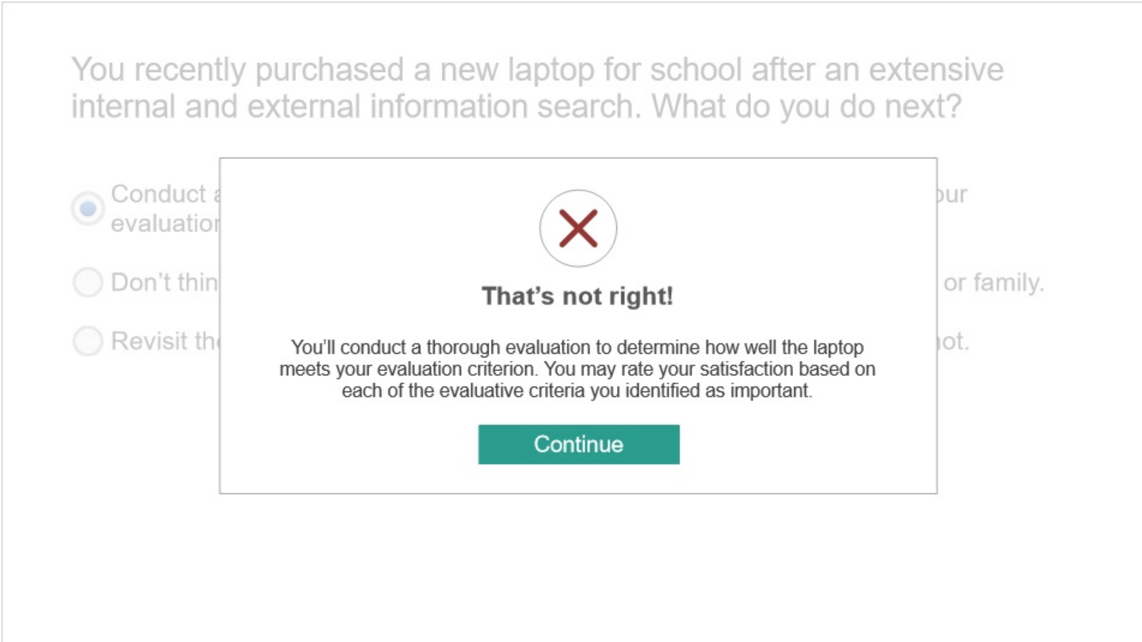
of market
aunch a lot
want.
That’s right!
Continue

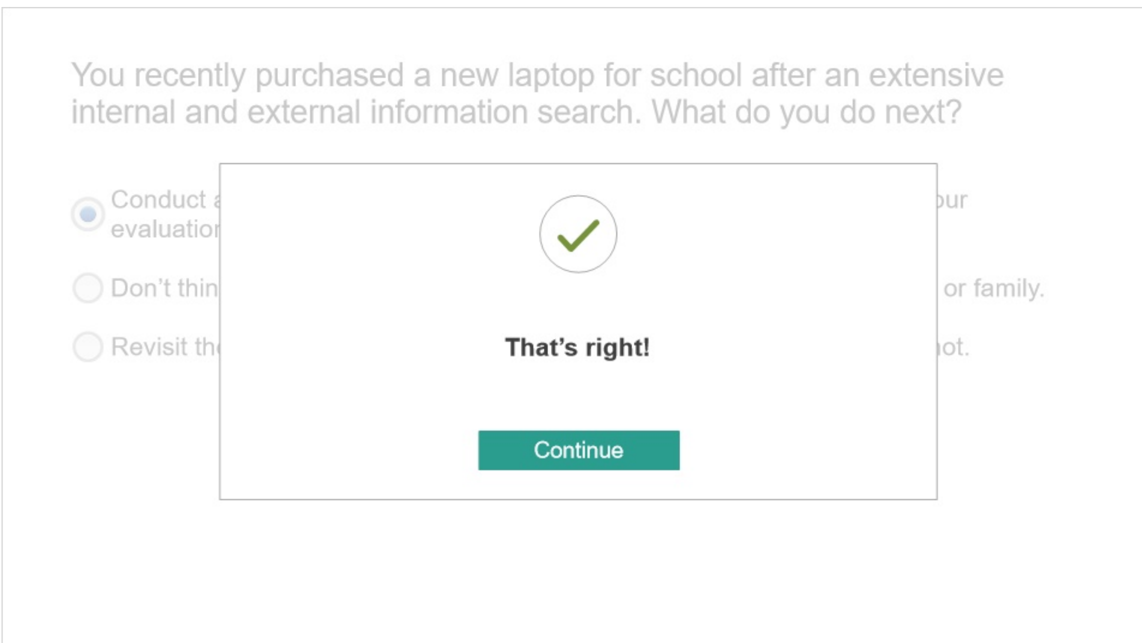
Review Question 6
(Multiple Choice, 1 attempt permitted)


You recently purchased a new laptop for school after an extensive internal and external information search. What do you do next?

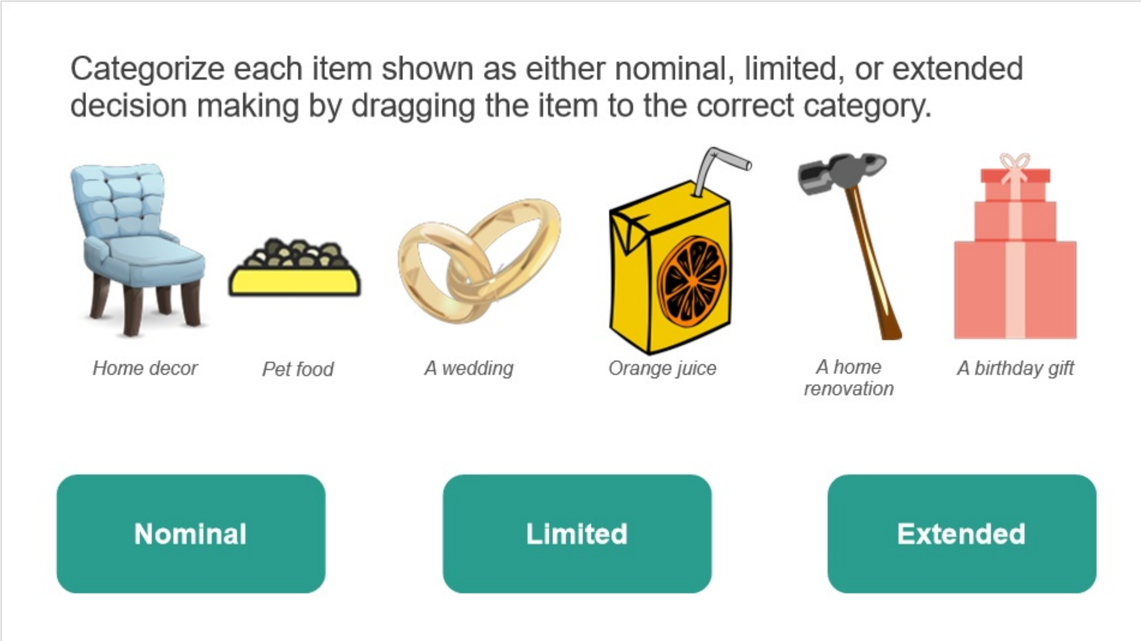
- (selected) Conduct a thorough evaluation to determine how well the laptop meets your evaluation criterion.
- Don’t think about the purchase again and never mention it to your friends or family.
- Revisit the purchase after a year or so to determine if you’re satisfied or not.

Correct	Choice
X	Conduct a thorough evaluation to determine how well the laptop meets your evaluation criterion.
	Don’t think about the purchase again and never mention it to your friends or family.
	Revisit the purchase after a year or so to determine if you’re satisfied or not.


You recently purchased a new laptop for school after an extensive internal and external information search. What do you do next?
Conduct a
evaluation
our
Don't thin
or family.
Revisit th
ot.
That's not right!
You'll conduct a thorough evaluation to determine how well the laptop meets your evaluation criterion. You may rate your satisfaction based on each of the evaluative criteria you identified as important.
Continue

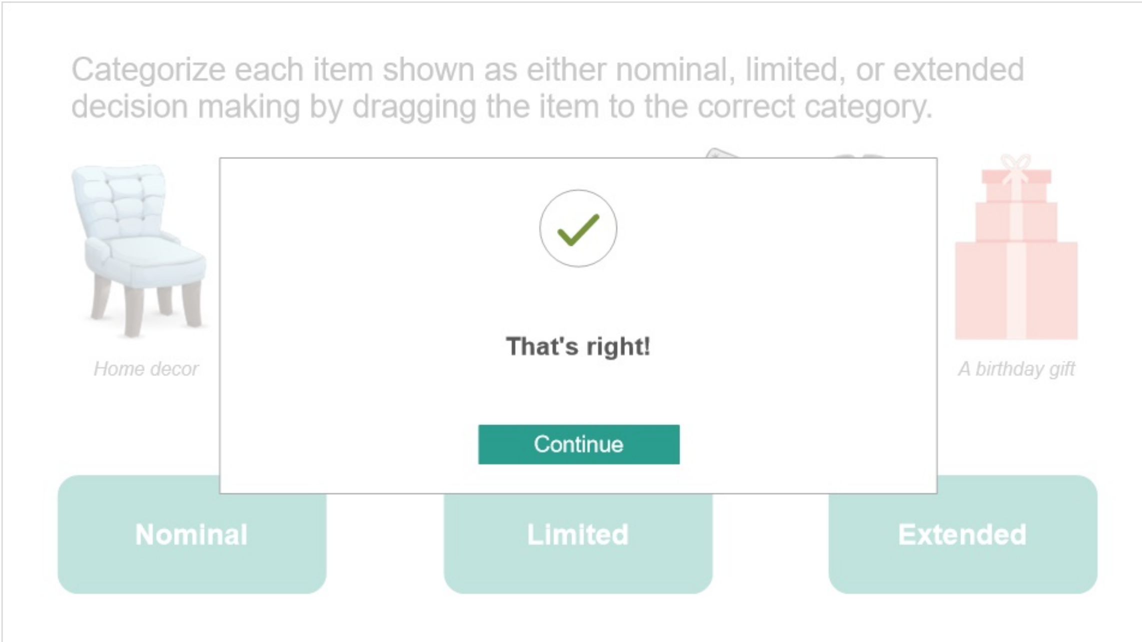

You recently purchased a new laptop for school after an extensive internal and external information search. What do you do next?
Conduct a
evaluation
our
Don't thin
or family.
Revisit th
ot.
That's right!
Continue

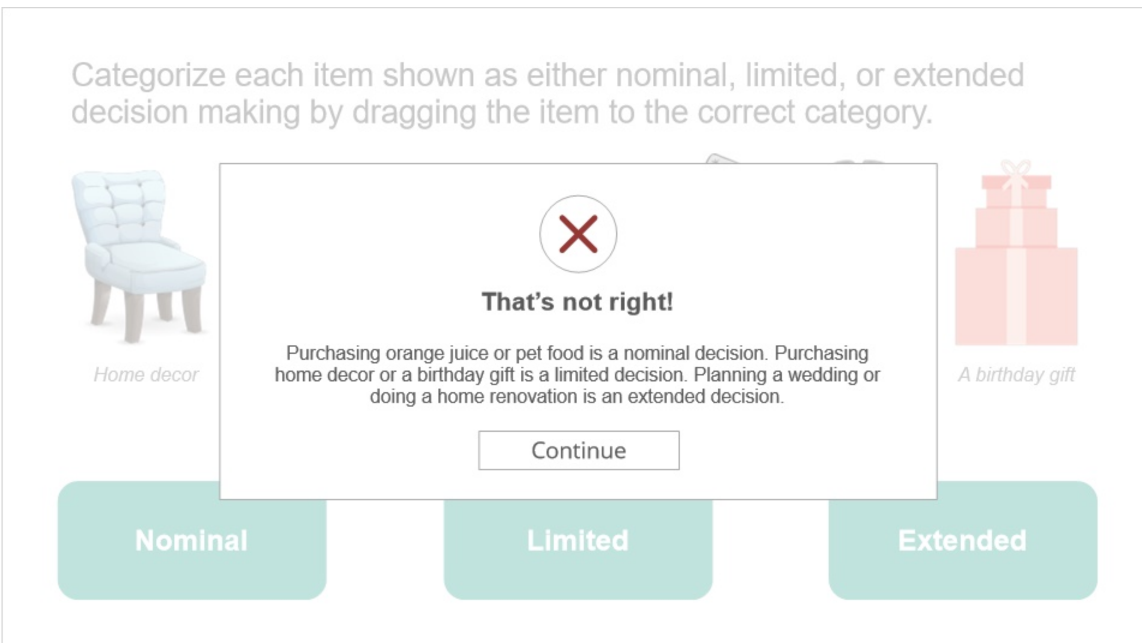
Review Question 7
(Drag and drop, 1 attempt permitted)



Drag Item	Drop Target
orange juice	Nominal
wedding	Extended
home decor	Limited
pet food	Nominal
home reno	Extended
bday gift	Limited

Drag and drop properties
Snap dropped items to drop target (Stack random)
Delay item drop states until interaction is submitted


Categorize each item shown as either nominal, limited, or extended decision making by dragging the item to the correct category.
Home decor
A birthday gift
That's right!
Continue
Nominal
Limited
Extended


Categorize each item shown as either nominal, limited, or extended decision making by dragging the item to the correct category.
Home decor
A birthday gift
That's not right!
Purchasing orange juice or pet food is a nominal decision. Purchasing home decor or a birthday gift is a limited decision. Planning a wedding or doing a home renovation is an extended decision.
Continue
Nominal
Limited
Extended

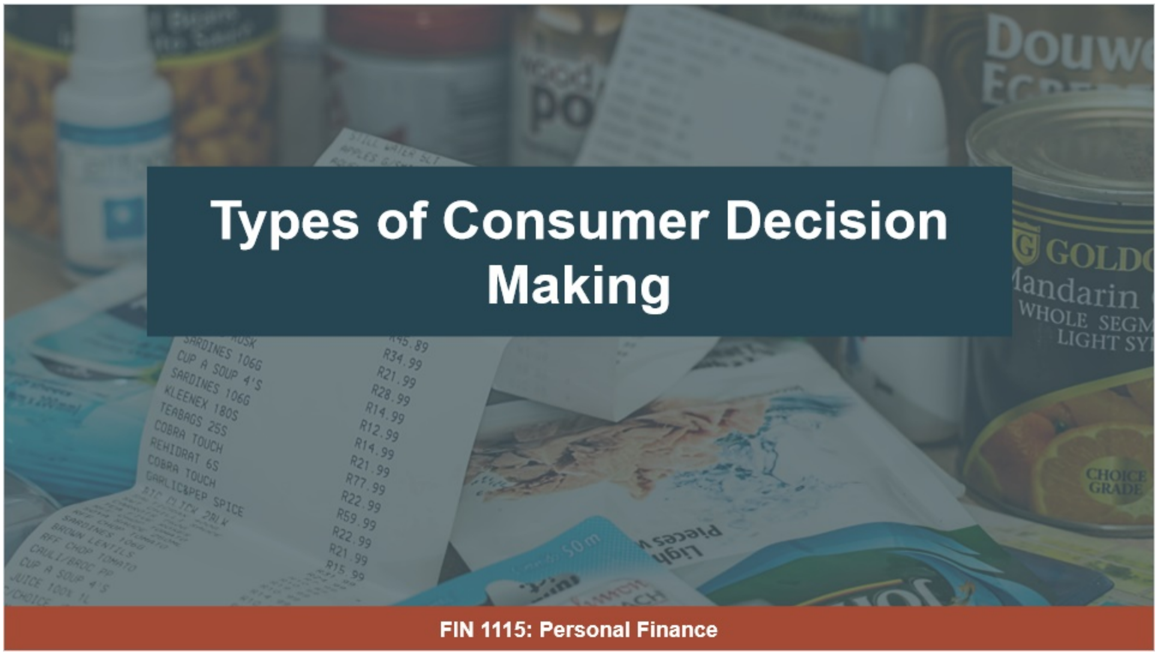
Module Complete!

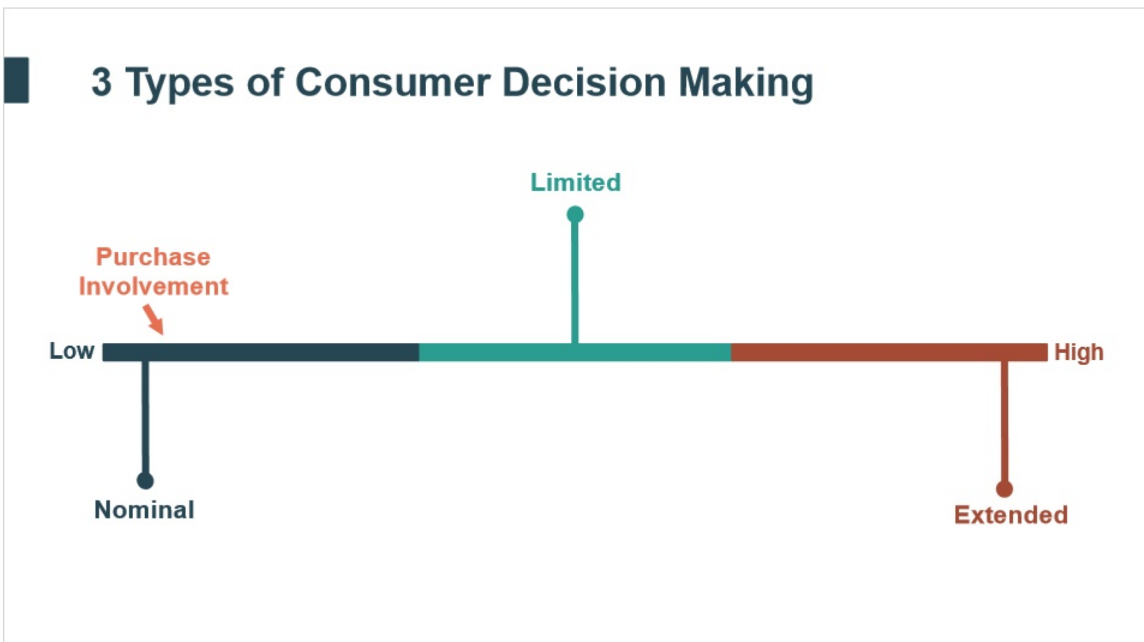
Exit this module by clicking the button below.

Once you exit, go back to the course page on Moodle and **complete the posttest** under this week's course materials.

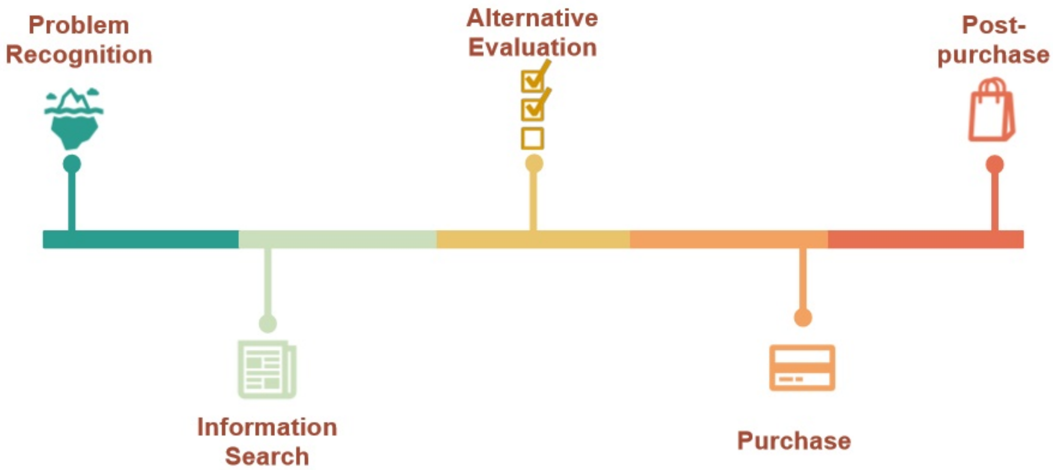
Exit Module

No Segmenting – Pretraining (PM Treatment)





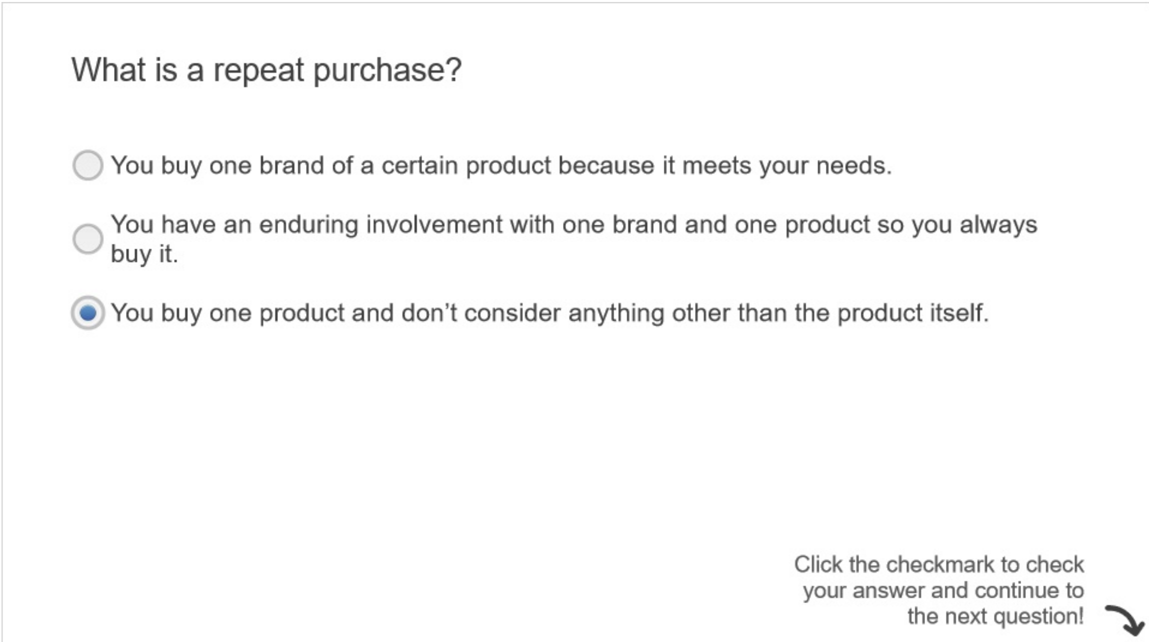
Consumer Decision Making Process



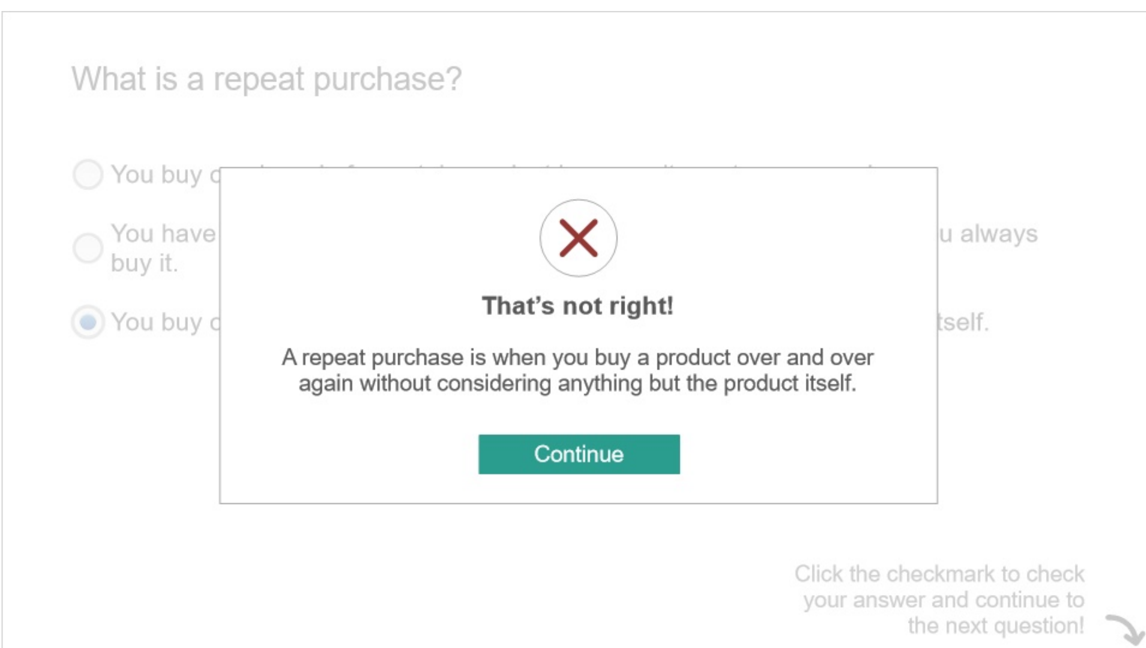
The Decision Making Process

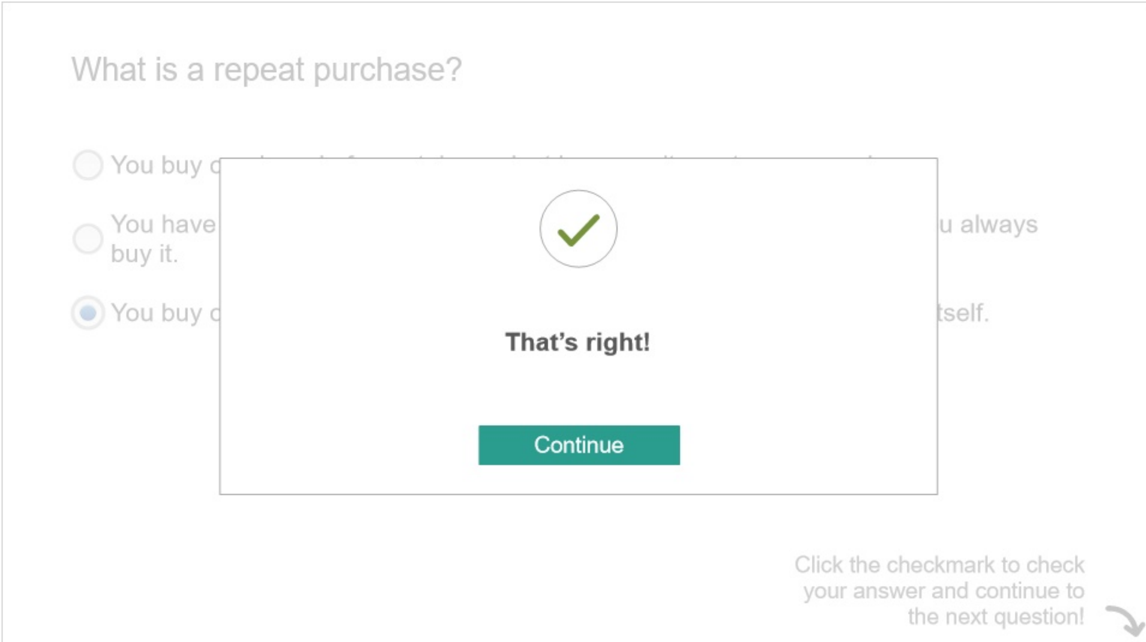
Type	Decision Making Process				
	Problem Recognition	Information Search	Alternative Evaluation	Purchase	Post Purchase
Nominal	Selective	Limited internal	None	Low involvement	• No dissonance • Very limited evaluation

Review Question 1
(Multiple Choice, 1 attempt permitted)

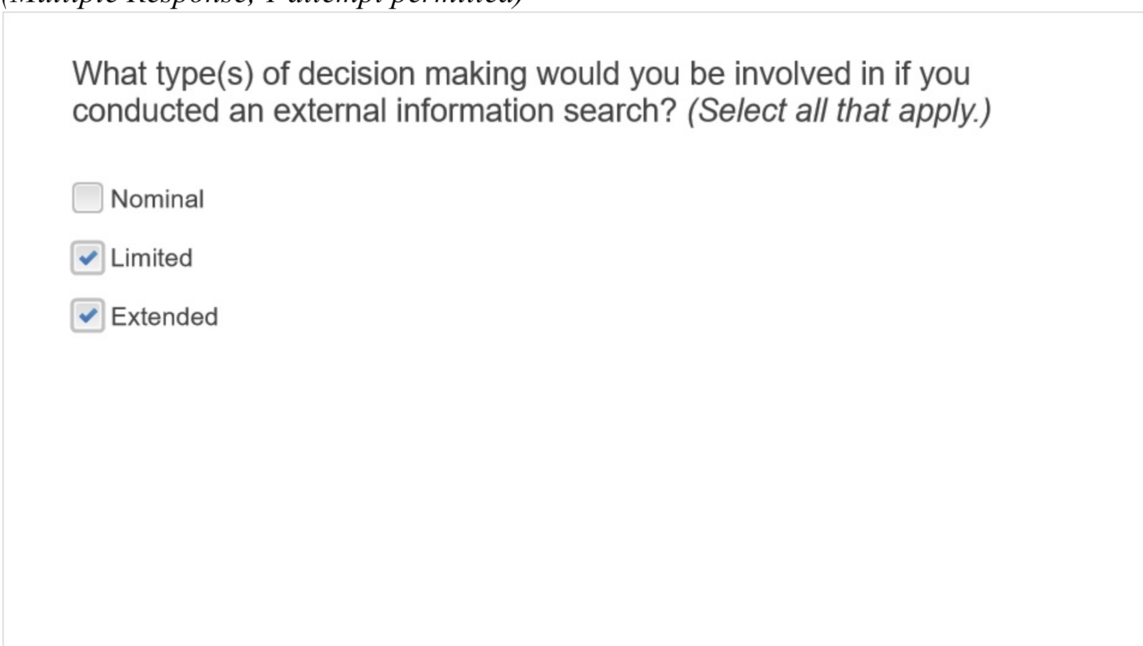


Correct	Choice
	You buy one brand of a certain product because it meets your needs.
	You have an enduring involvement with one brand and one product so you always buy it.
X	You buy one product and don't consider anything other than the product itself.

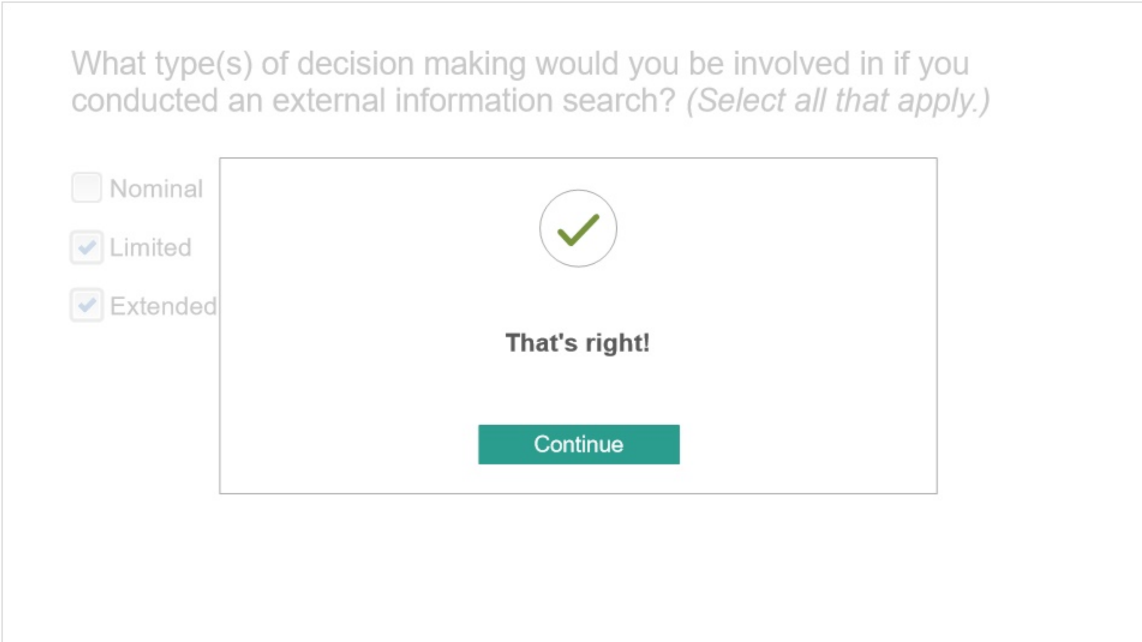


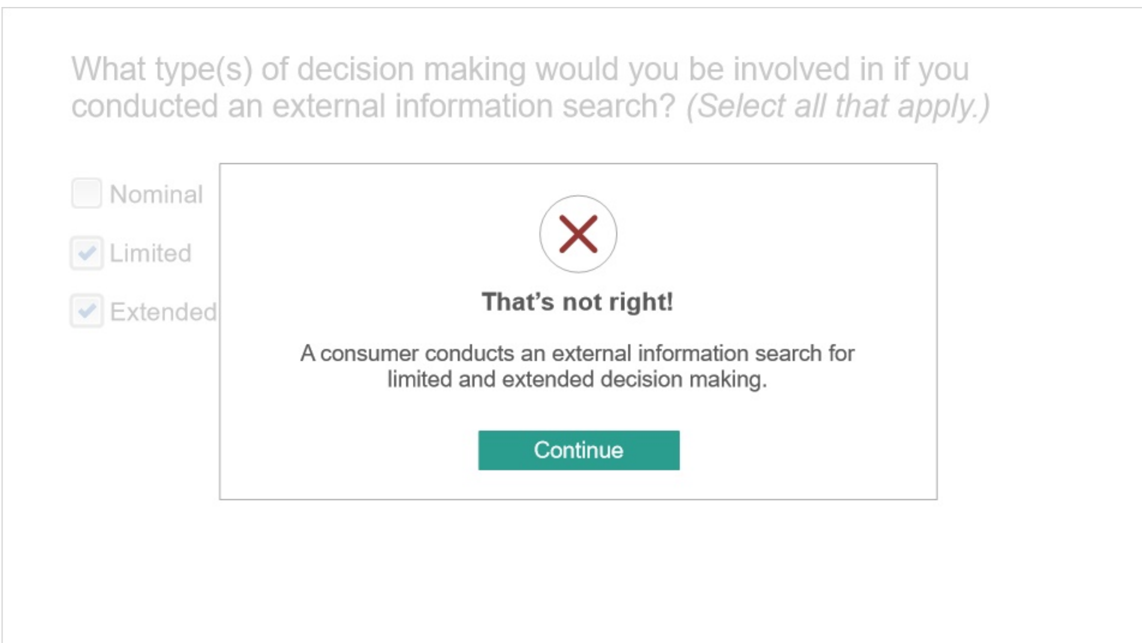


Review Question 2
(Multiple Response, 1 attempt permitted)



Correct	Choice
	Nominal
X	Limited
X	Extended


What type(s) of decision making would you be involved in if you conducted an external information search? *(Select all that apply.)*
Nominal
Limited
Extended
That's right!
Continue


What type(s) of decision making would you be involved in if you conducted an external information search? *(Select all that apply.)*
Nominal
Limited
Extended
That's not right!
A consumer conducts an external information search for limited and extended decision making.
Continue

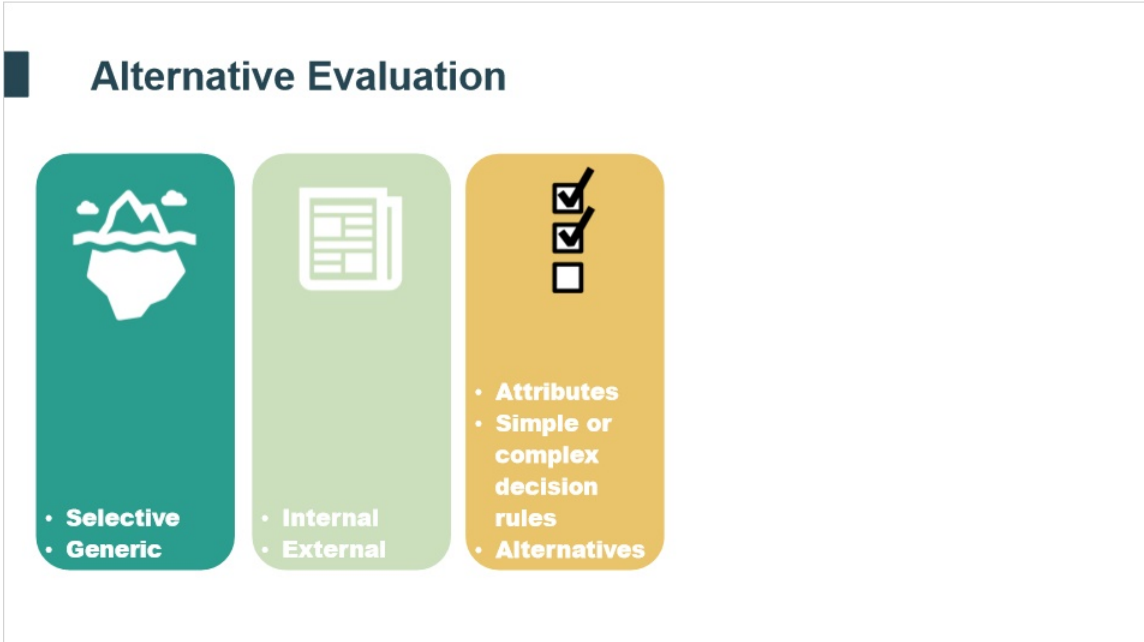
Problem Recognition

- Selective
- Generic

Information Search

- Selective
- Generic

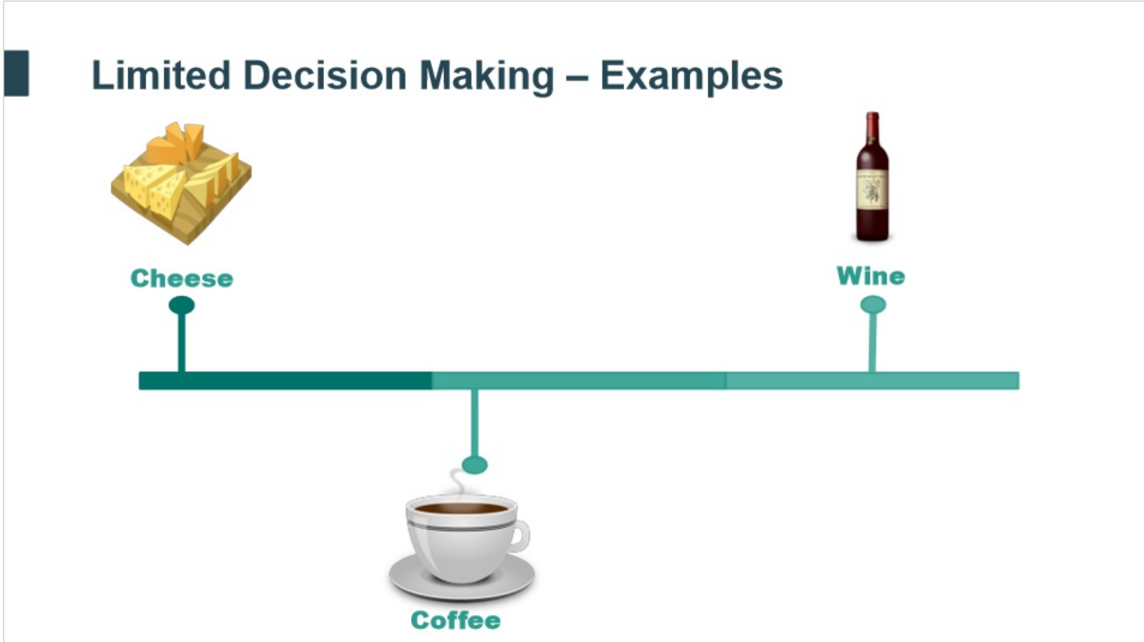
- Internal
- External

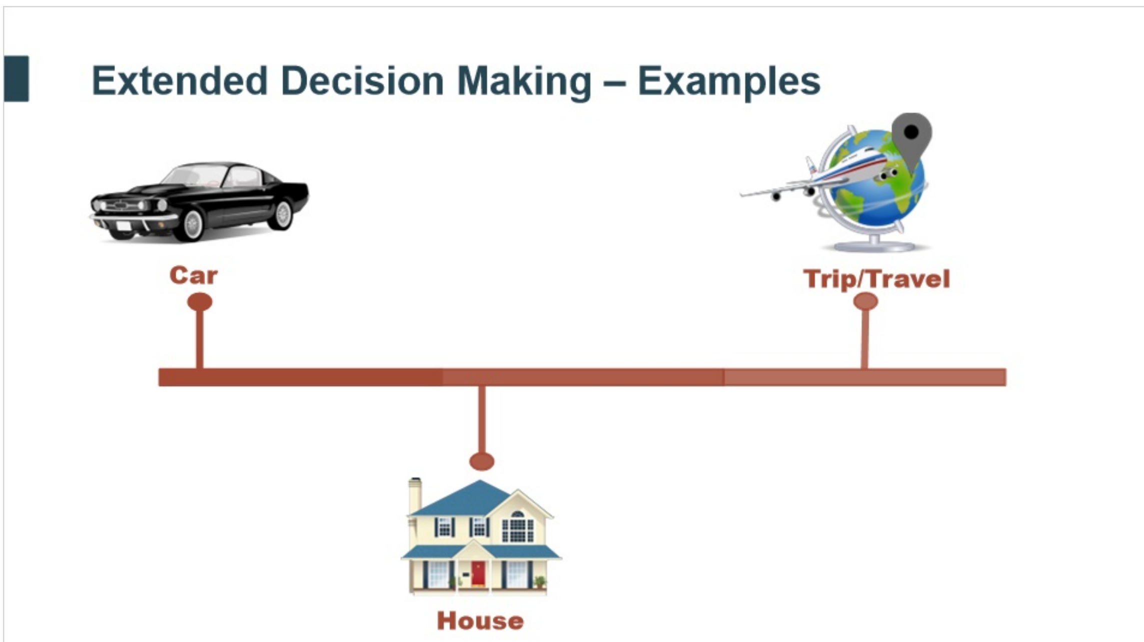

Alternative Evaluation
• Selective
• Generic
• Internal
• External
• Attributes
• Simple or complex decision rules
• Alternatives


Purchase
• Selective
• Generic
• Internal
• External
• Many attributes
• Simple or complex decision rules
• Many alternatives
• Low to high involvement


Post Purchase
• Selective
• Generic
• Internal
• External
• Many attributes
• Simple or complex decision rules
• Many alternatives
• Low to high involvement
• Dissonance
• Complex evaluation


Nominal Decision Making - Examples
Ketchup
Cleaning Products
Toothpaste


Limited Decision Making – Examples
Cheese
Wine
Coffee


Extended Decision Making – Examples
Car
Trip/Travel
House

Summary

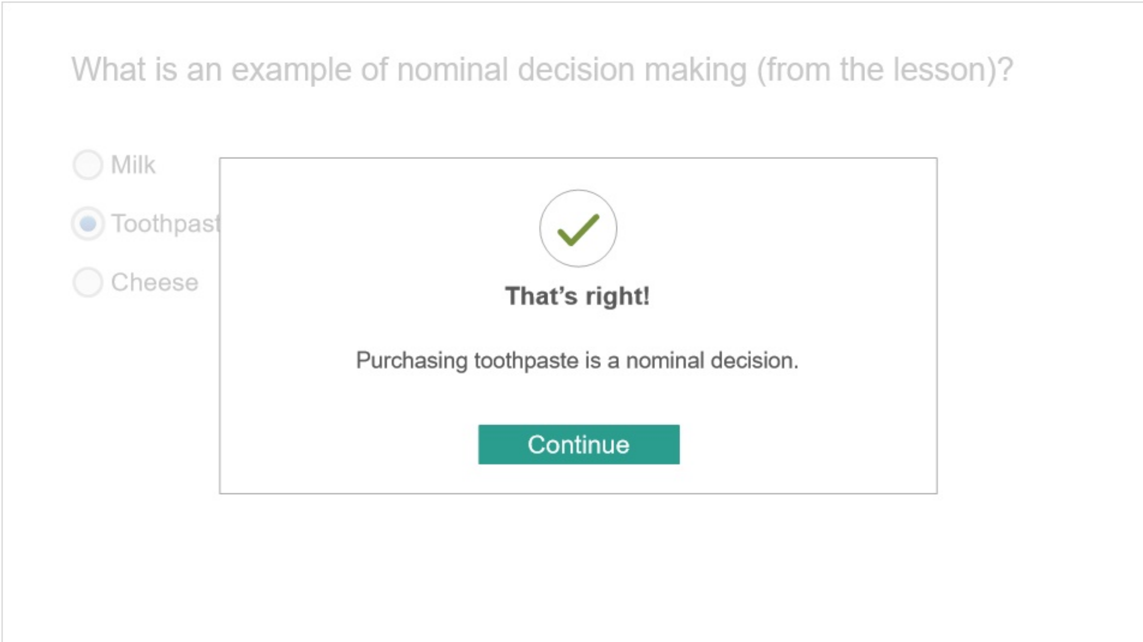
Type	Decision Making Process				
	Problem Recognition	Information Search	Alternative Evaluation	Purchase	Post Purchase
Nominal	Selective	Limited internal	None	Low involvement	• No dissonance • Very limited evaluation
Limited	Generic	• Internal • Limited external	• Few attributes • Simple decision rules • Few alternatives	Medium involvement	• No dissonance • Limited evaluation
Extended	Generic	• Internal • External	• Many attributes • Complex decisions rules • Many alternatives	High involvement	• Dissonance • Complex evaluation

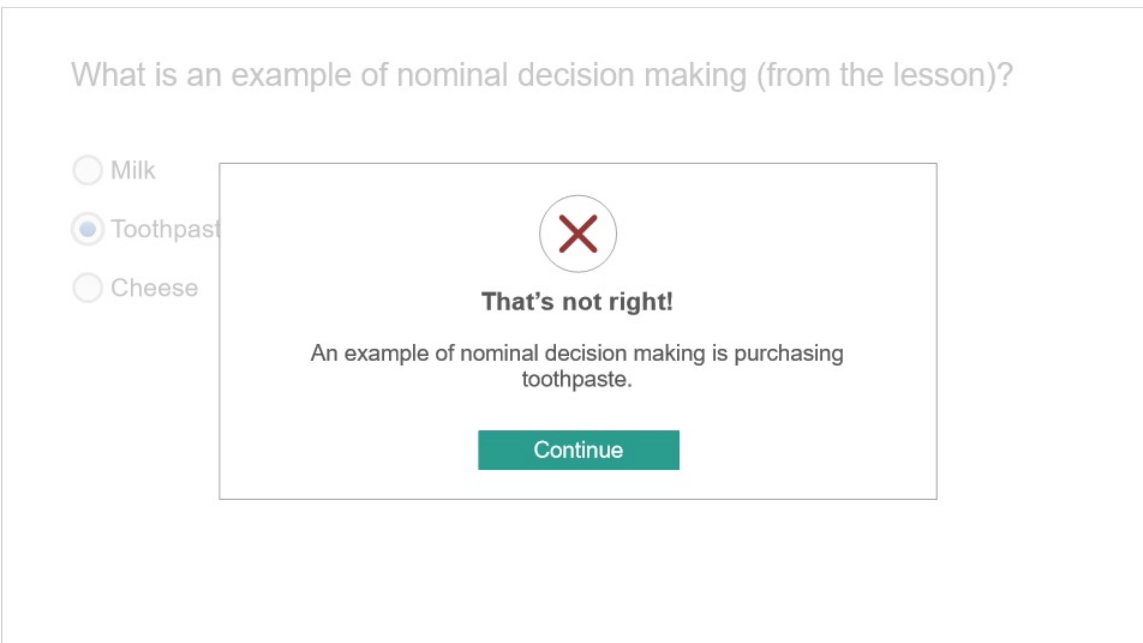
Review Question 3
(Multiple Choice, 1 attempt permitted)

What is an example of nominal decision making (from the lesson)?

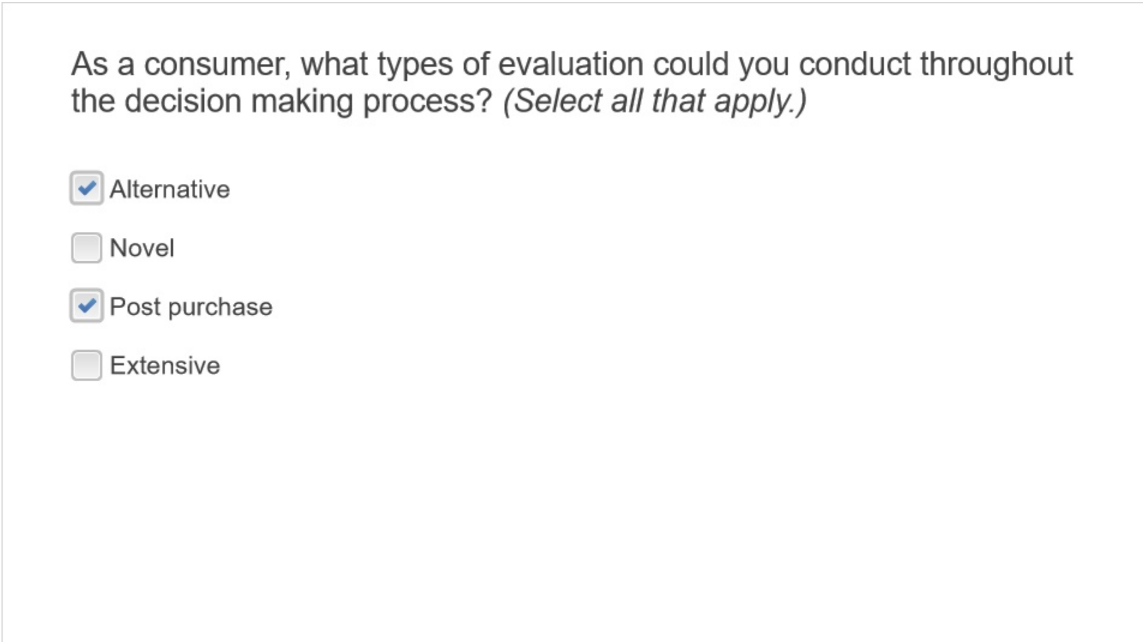
- Milk
- Toothpaste
- Cheese

Correct	Choice
	Milk
X	Toothpaste
	Cheese

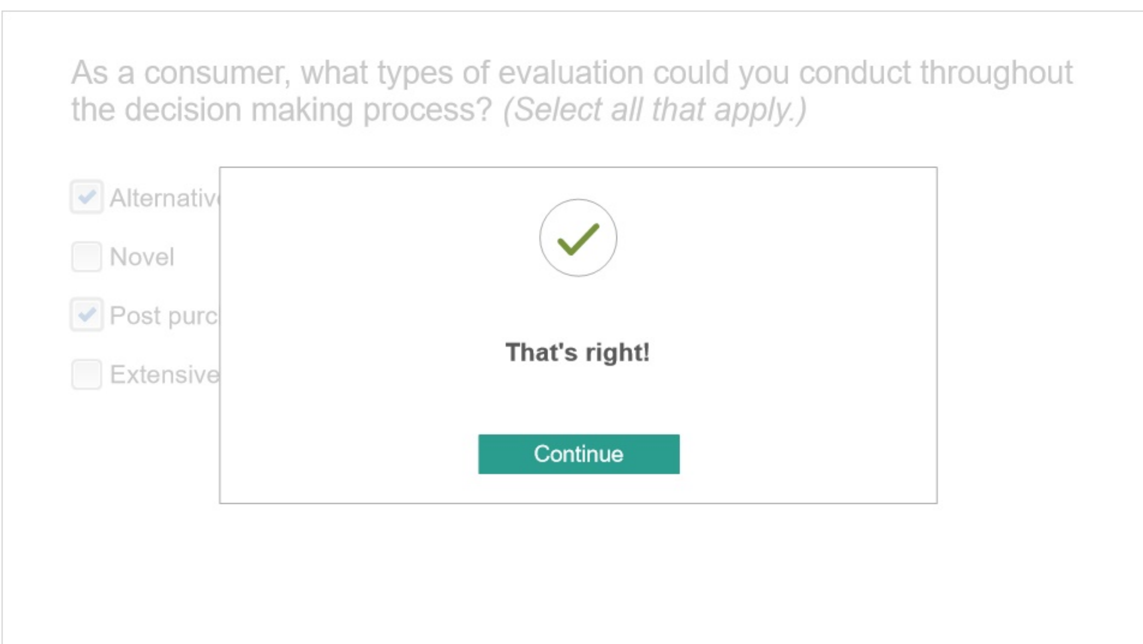

What is an example of nominal decision making (from the lesson)?
Milk
Toothpast
Cheese
That's right!
Purchasing toothpaste is a nominal decision.
Continue

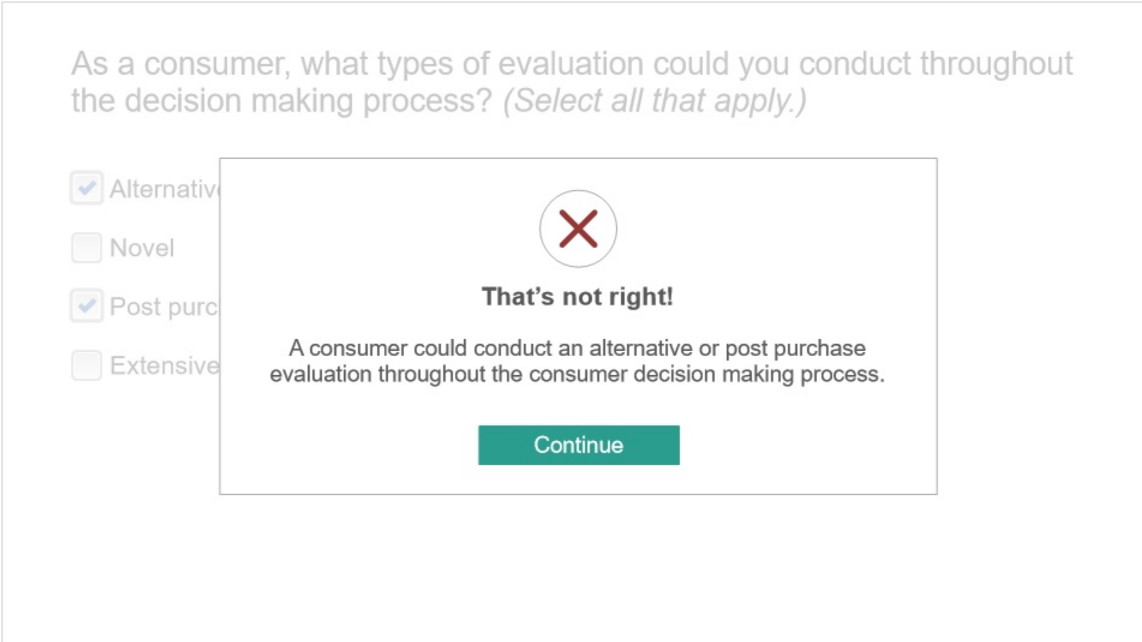

What is an example of nominal decision making (from the lesson)?
Milk
Toothpast
Cheese
That's not right!
An example of nominal decision making is purchasing toothpaste.
Continue

Review Question 4
(Multiple Response, 1 attempt permitted)

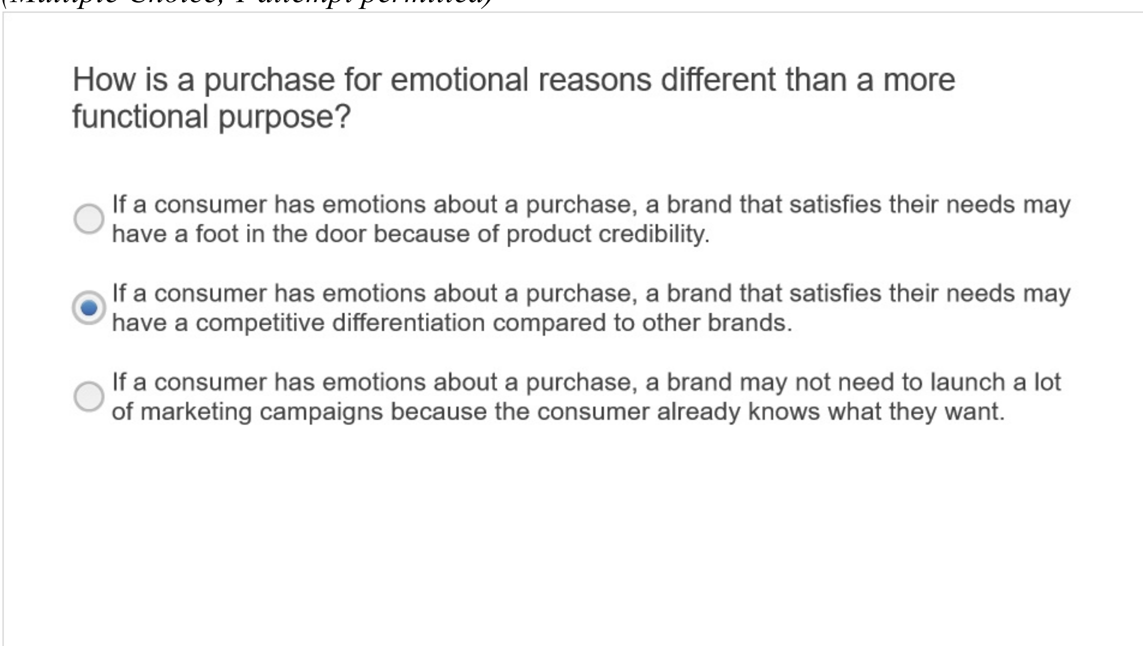


Correct	Choice
X	Alternative
	Novel
X	Post purchase
	Extensive

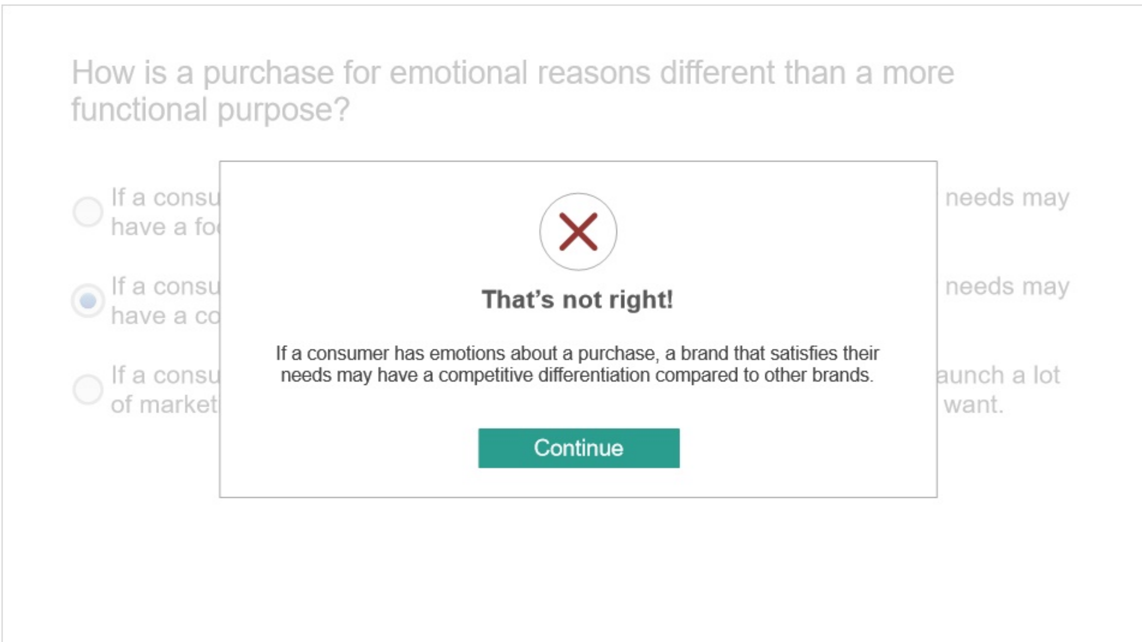


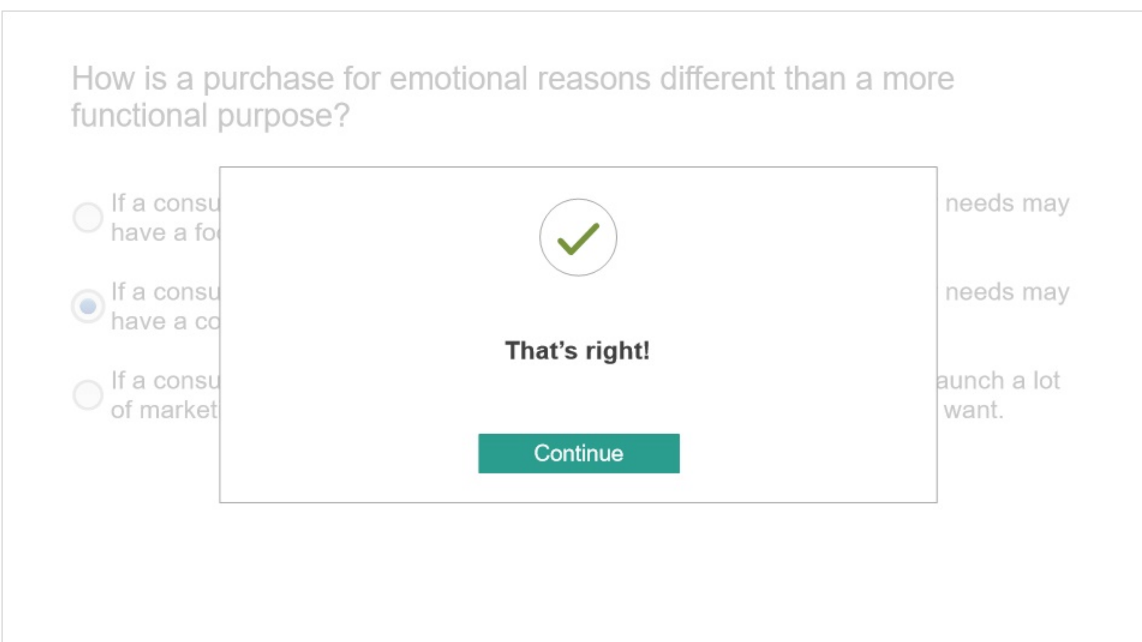


Review Question 5
(Multiple Choice, 1 attempt permitted)



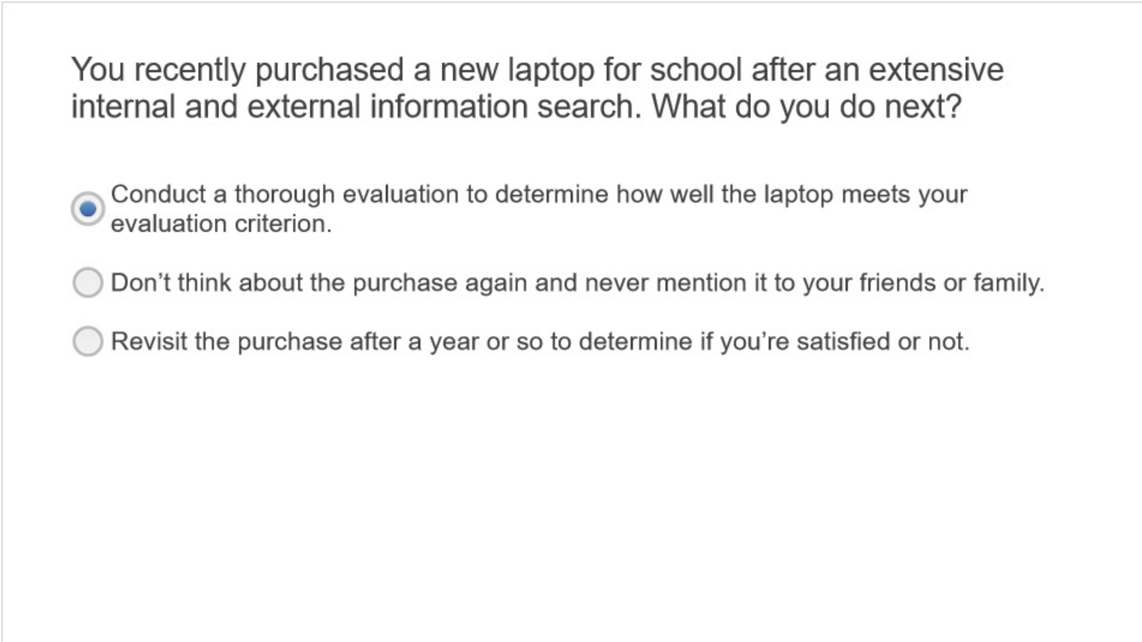
Correct	Choice
	If a consumer has emotions about a purchase, a brand that satisfies their needs may have a foot in the door because of product credibility.
X	If a consumer has emotions about a purchase, a brand that satisfies their needs may have a competitive differentiation compared to other brands.
	If a consumer has emotions about a purchase, a brand may not need to launch a lot of marketing campaigns because the consumer already knows what they want.



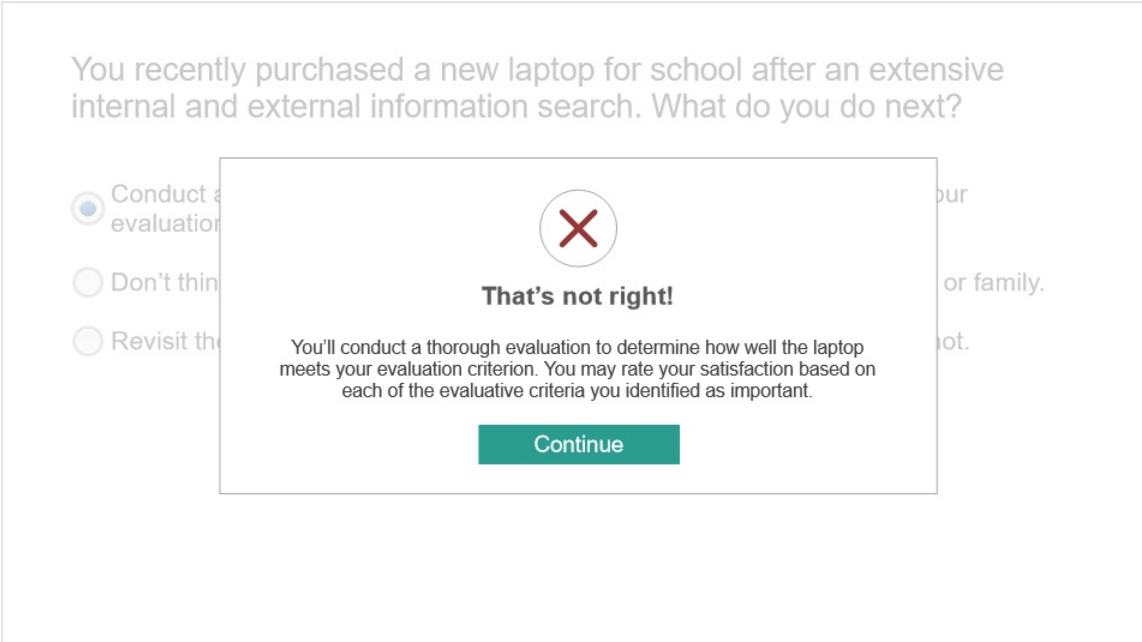


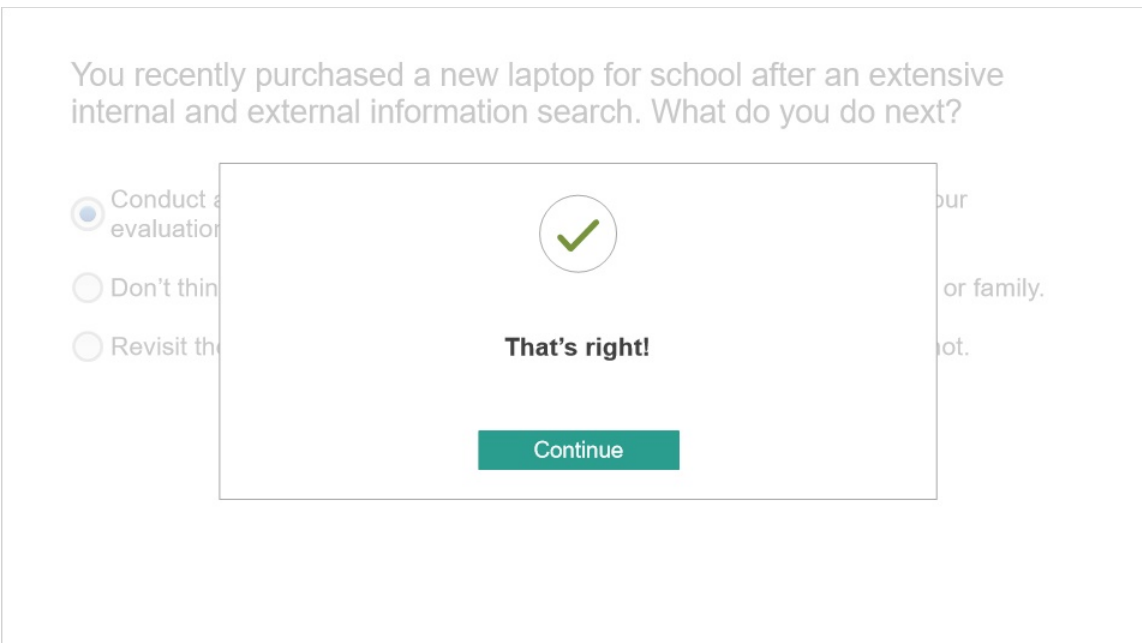
Review Question 6

(Multiple Choice, 1 attempt permitted)

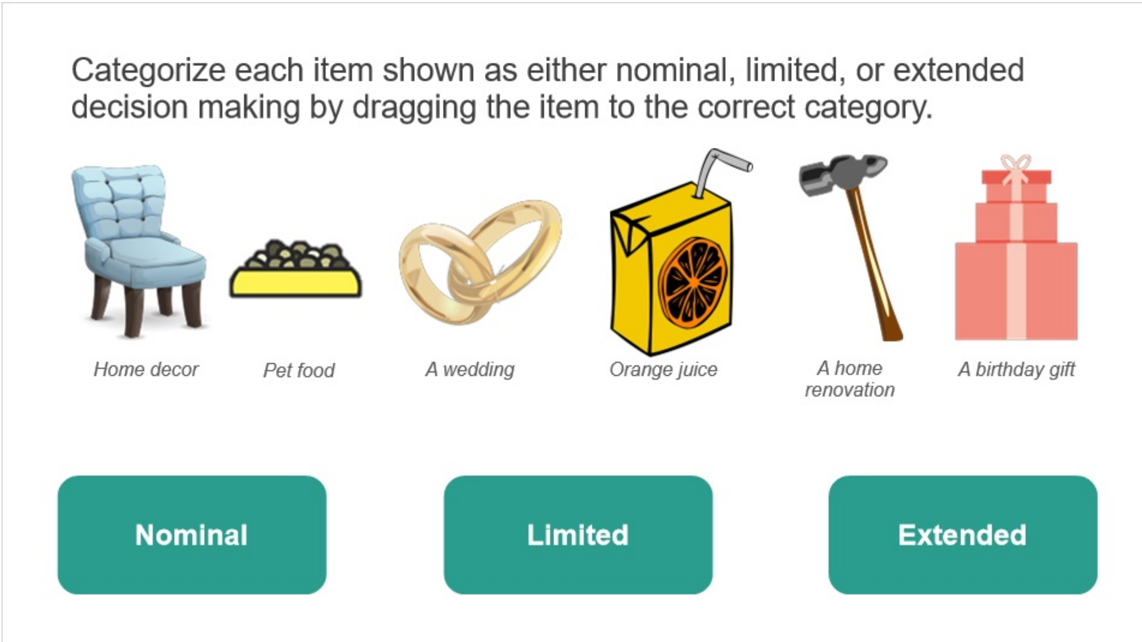


Correct	Choice
X	Conduct a thorough evaluation to determine how well the laptop meets your evaluation criterion.
	Don’t think about the purchase again and never mention it to your friends or family.
	Revisit the purchase after a year or so to determine if you’re satisfied or not.


You recently purchased a new laptop for school after an extensive internal and external information search. What do you do next?
Conduct a
evaluation
our
Don't thin
or family.
Revisit th
ot.
That's not right!
You'll conduct a thorough evaluation to determine how well the laptop meets your evaluation criterion. You may rate your satisfaction based on each of the evaluative criteria you identified as important.
Continue

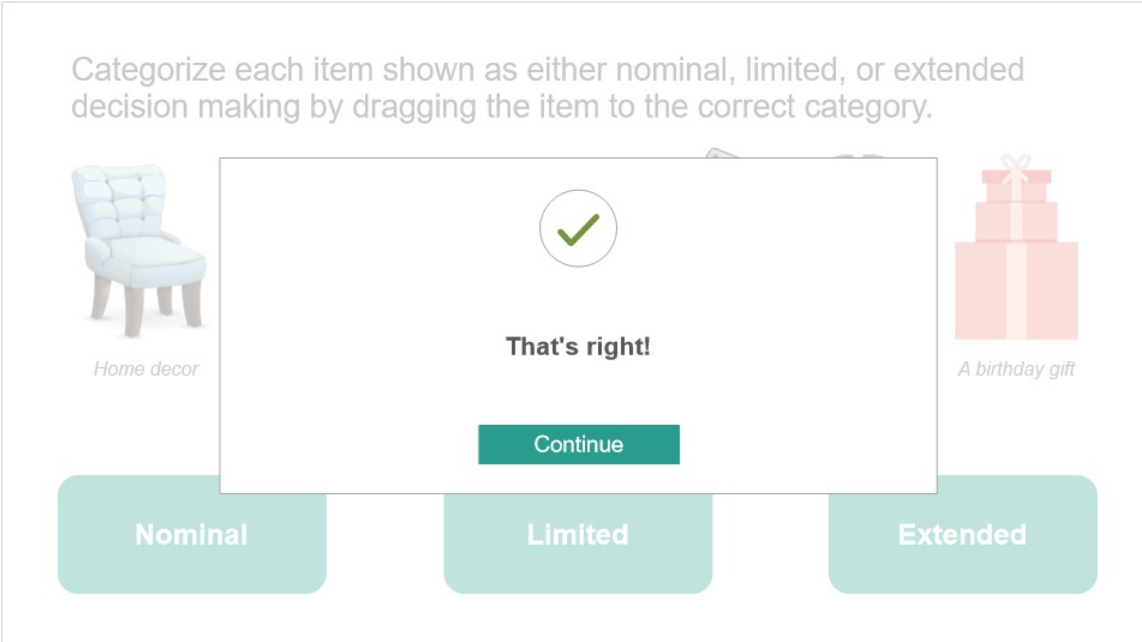

You recently purchased a new laptop for school after an extensive internal and external information search. What do you do next?
Conduct a
evaluation
our
Don't thin
or family.
Revisit th
ot.
That's right!
Continue

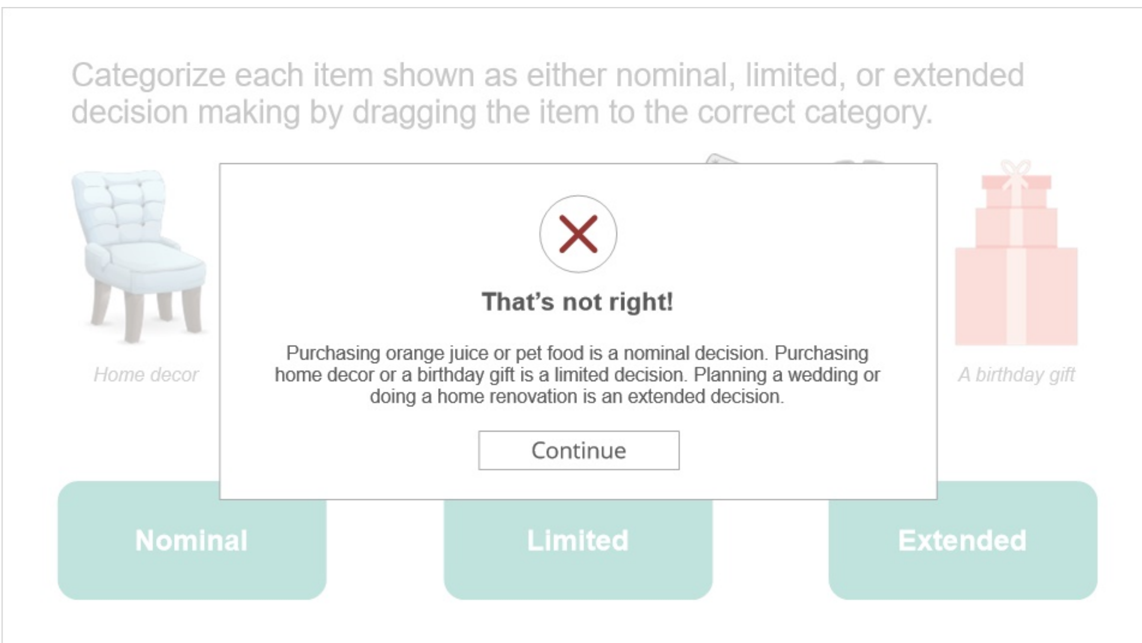
Review Question 7
(Drag and drop, 1 attempt permitted)



Drag Item	Drop Target
orange juice	Nominal
wedding	Extended
home decor	Limited
pet food	Nominal
home reno	Extended
bday gift	Limited

Drag and drop properties
Snap dropped items to drop target (Stack random)
Delay item drop states until interaction is submitted


Categorize each item shown as either nominal, limited, or extended decision making by dragging the item to the correct category.
Home decor
A birthday gift
That's right!
Continue
Nominal
Limited
Extended


Categorize each item shown as either nominal, limited, or extended decision making by dragging the item to the correct category.
Home decor
A birthday gift
That's not right!
Purchasing orange juice or pet food is a nominal decision. Purchasing home decor or a birthday gift is a limited decision. Planning a wedding or doing a home renovation is an extended decision.
Continue
Nominal
Limited
Extended

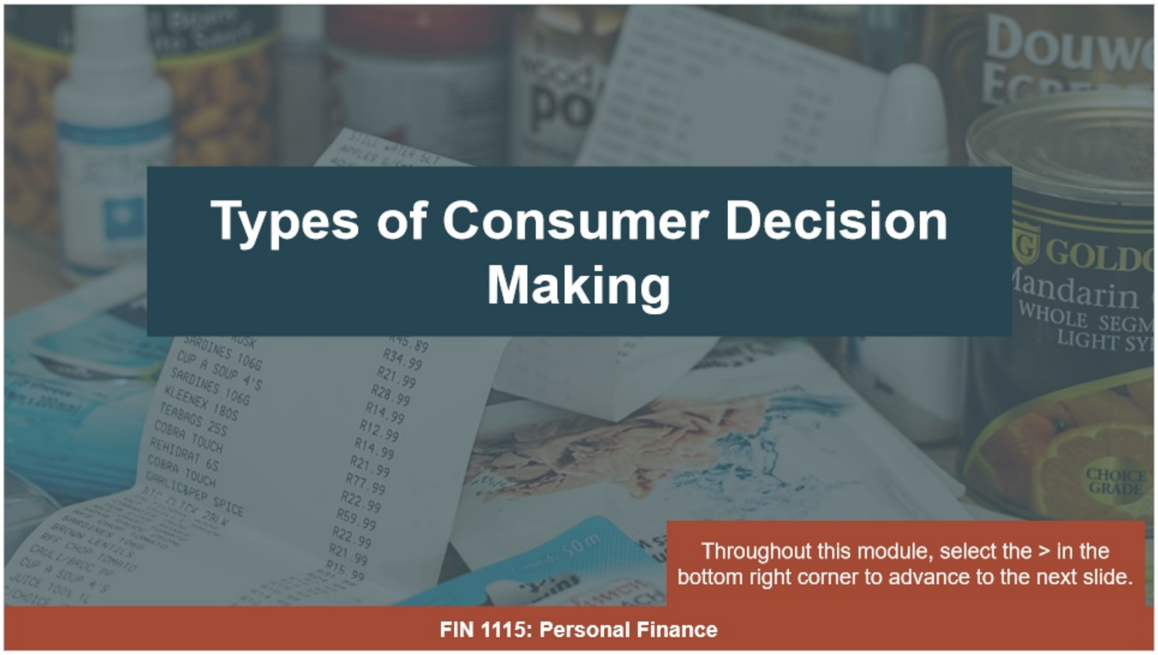
Module Complete!

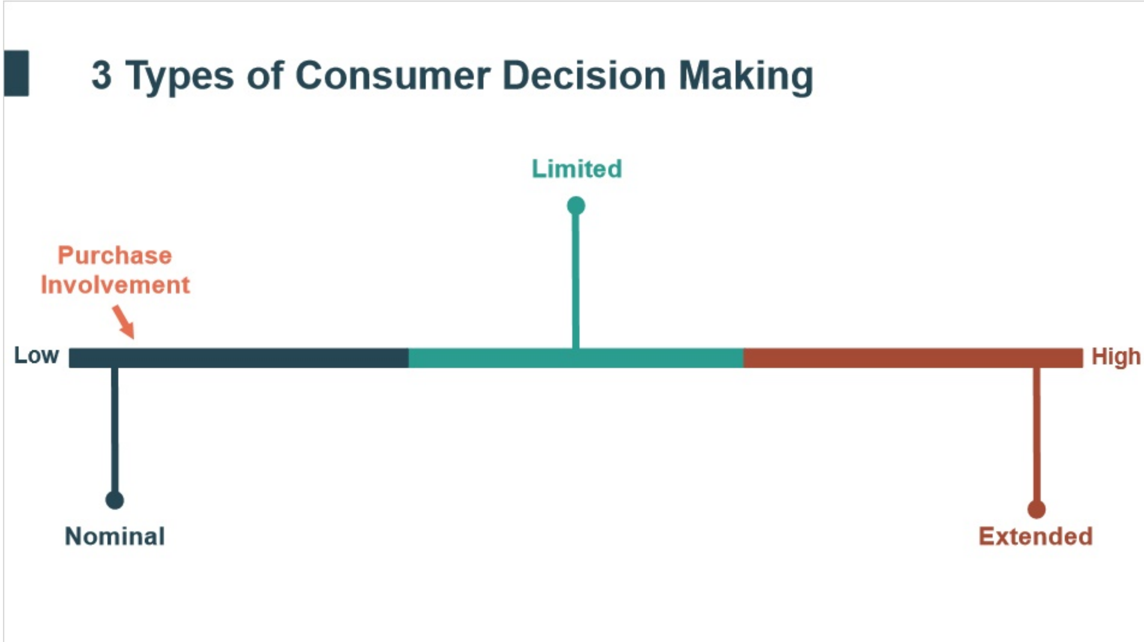
Exit this module by clicking the button below.

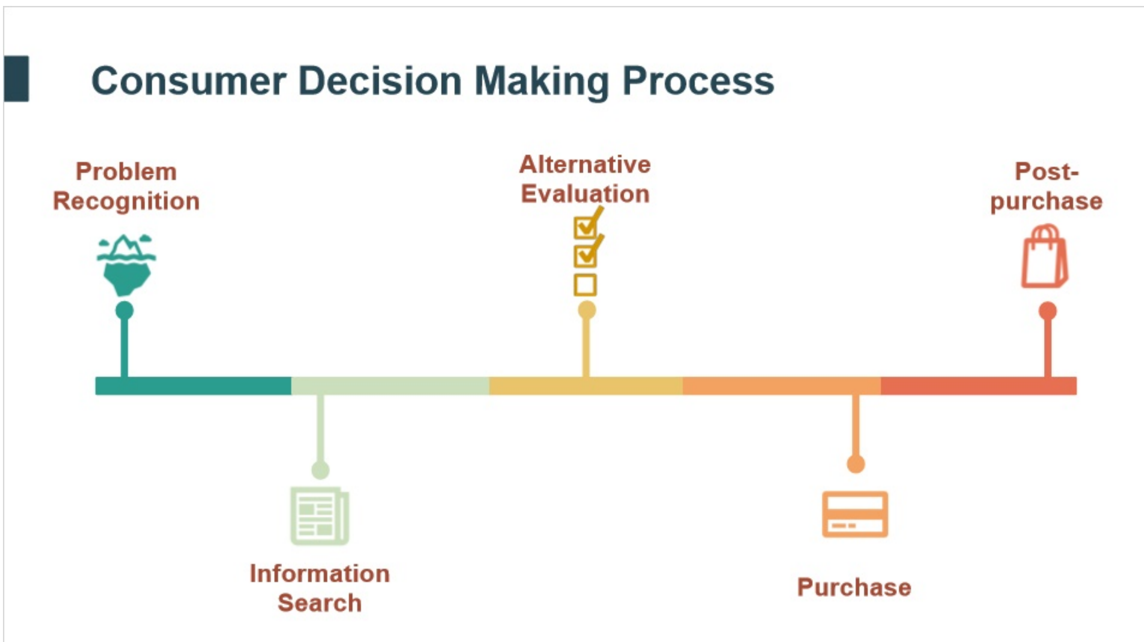
Once you exit, go back to the course page on Moodle and **complete the posttest** under this week's course materials.

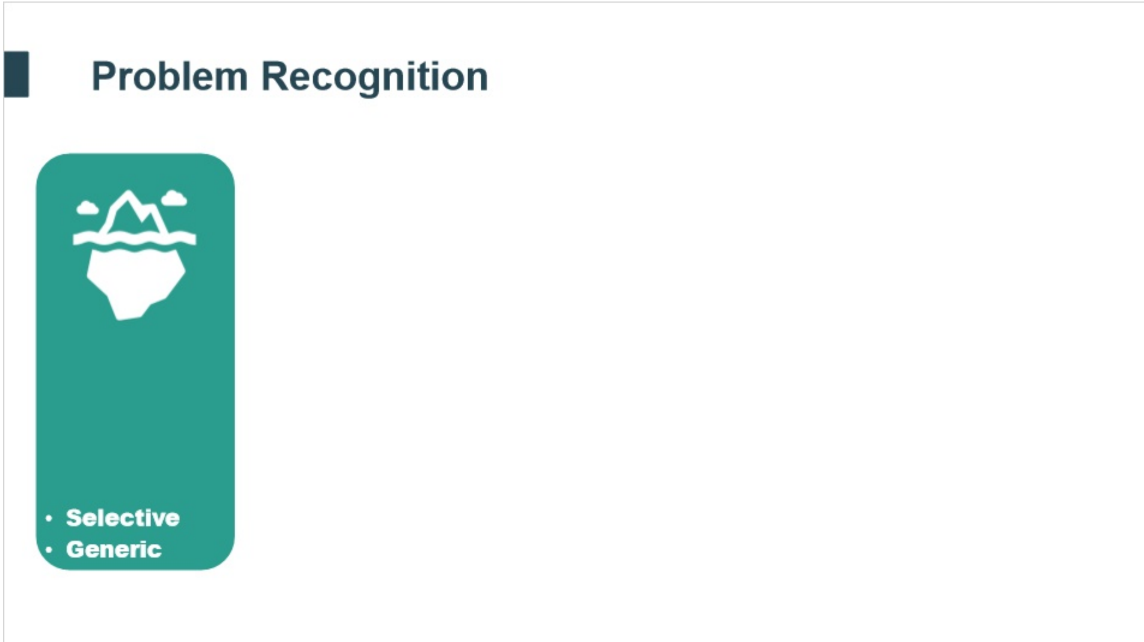
Exit Module

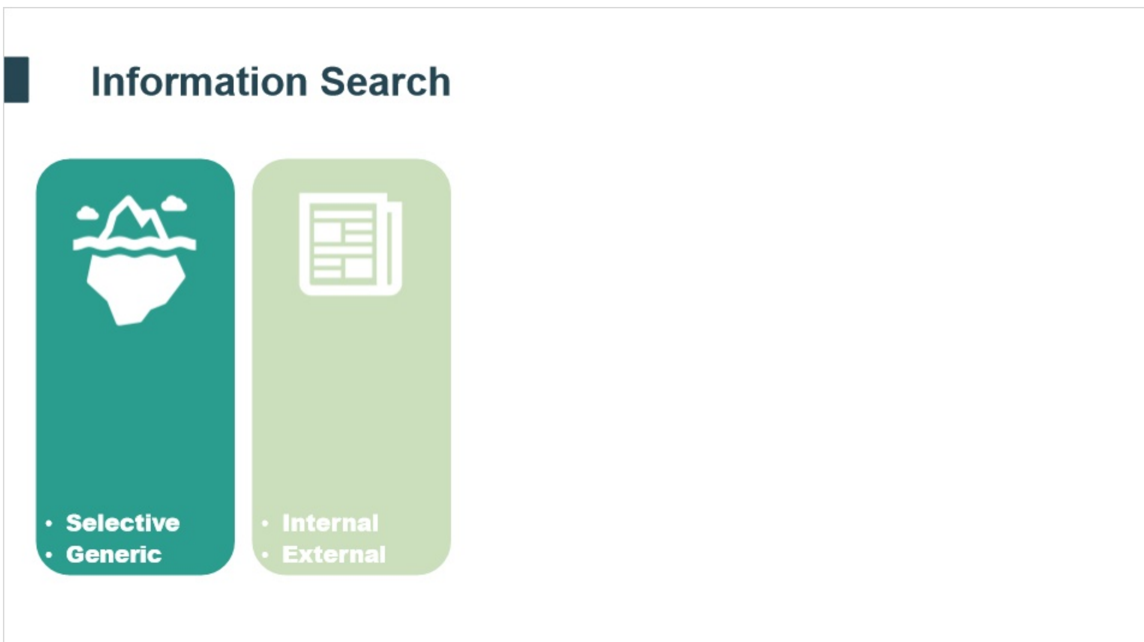
Segmenting – No Pretraining (SM Treatment)

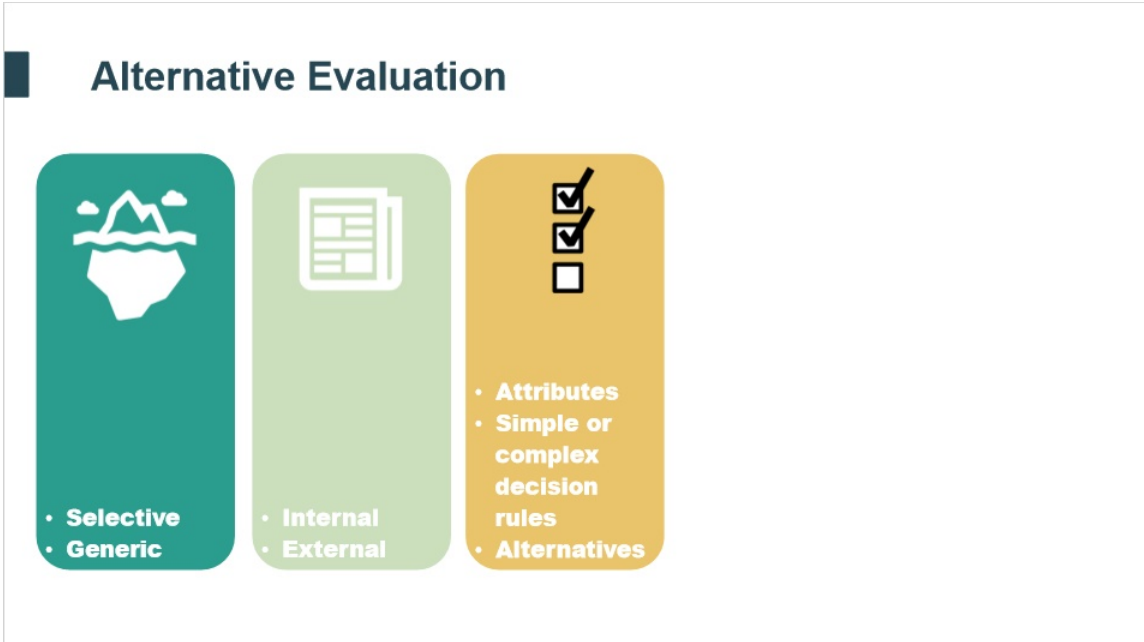



3 Types of Consumer Decision Making
Limited
Purchase Involvement
Low
High
Nominal
Extended


Consumer Decision Making Process
Problem Recognition
Alternative Evaluation
Post-purchase
Information Search
Purchase

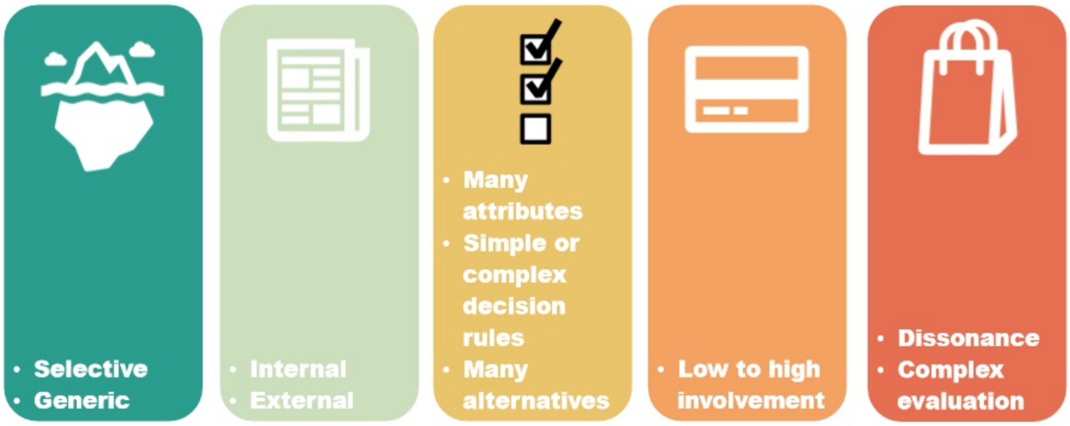

Problem Recognition
• Selective
• Generic


Information Search
• Selective
• Generic
• Internal
• External


Alternative Evaluation
• Selective
• Generic
• Internal
• External
• Attributes
• Simple or complex decision rules
• Alternatives


Purchase
• Selective
• Generic
• Internal
• External
• Many attributes
• Simple or complex decision rules
• Many alternatives
• Low to high involvement

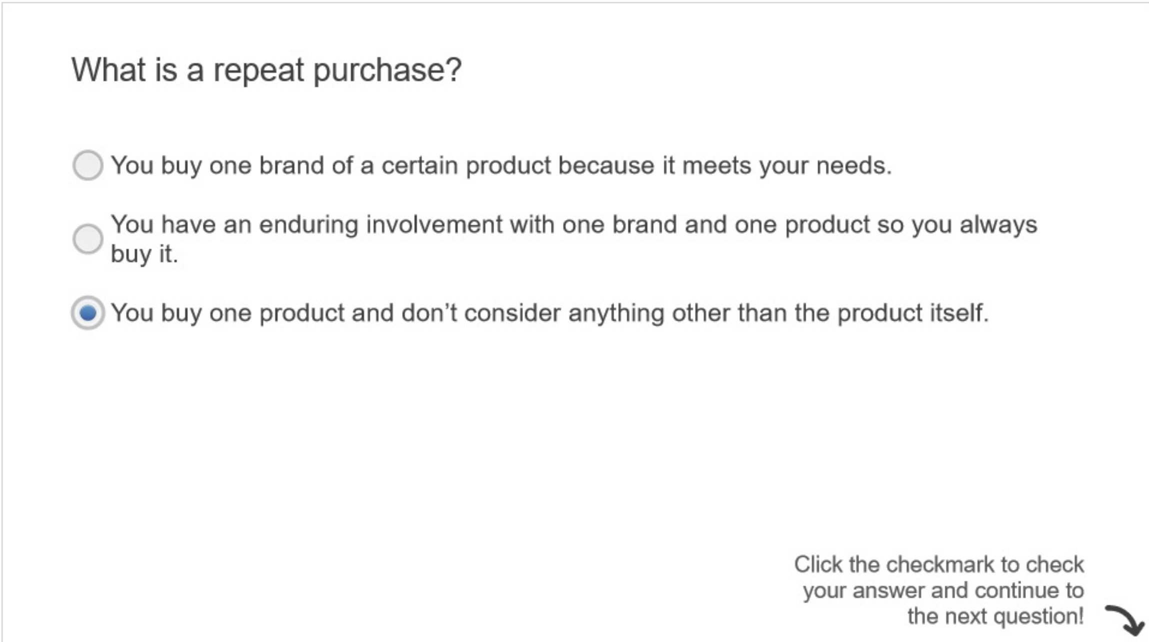
Post Purchase



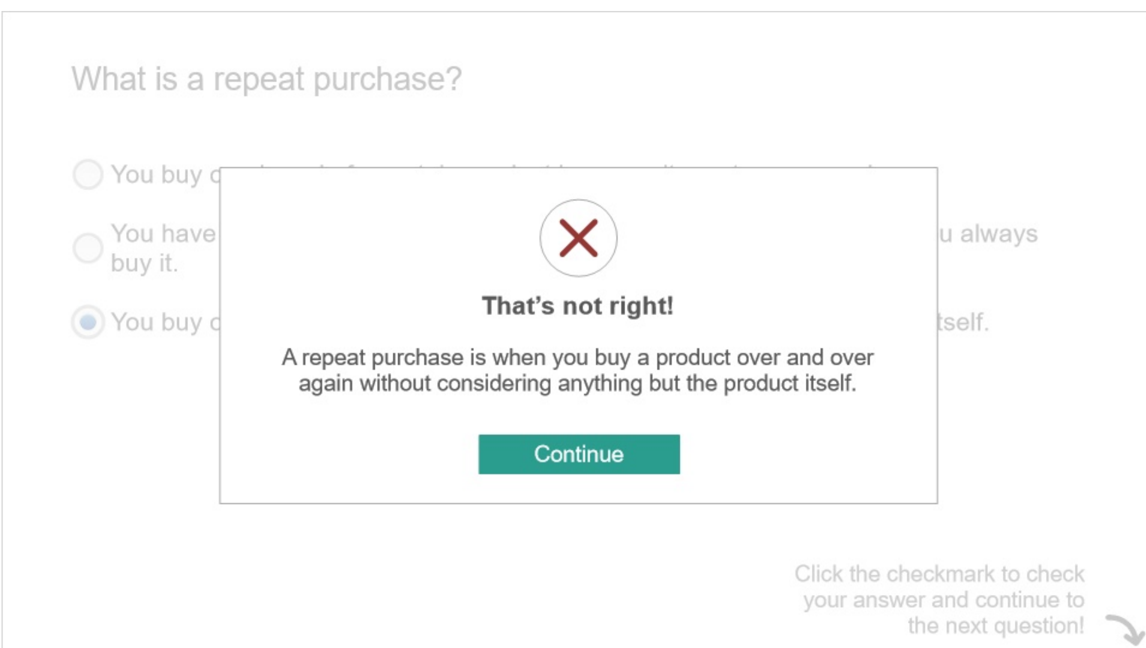
The Decision Making Process

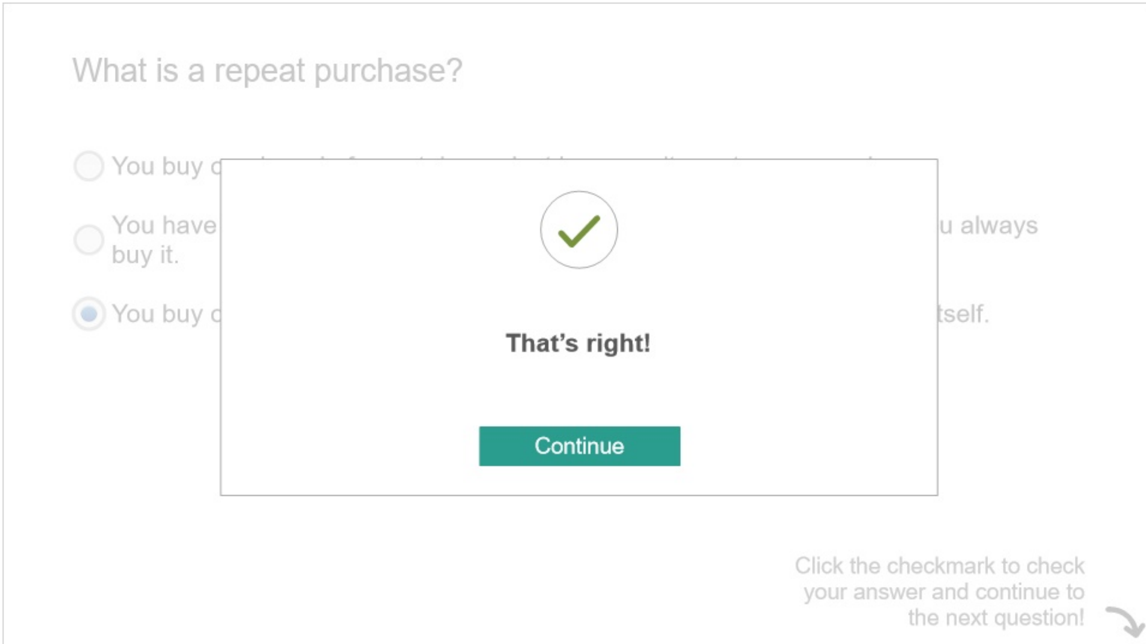
Type	Decision Making Process				
	Problem Recognition	Information Search	Alternative Evaluation	Purchase	Post Purchase
Nominal	Selective	Limited internal	None	Low involvement	• No dissonance • Very limited evaluation

Review Question 1
(Multiple Choice, 1 attempt permitted)

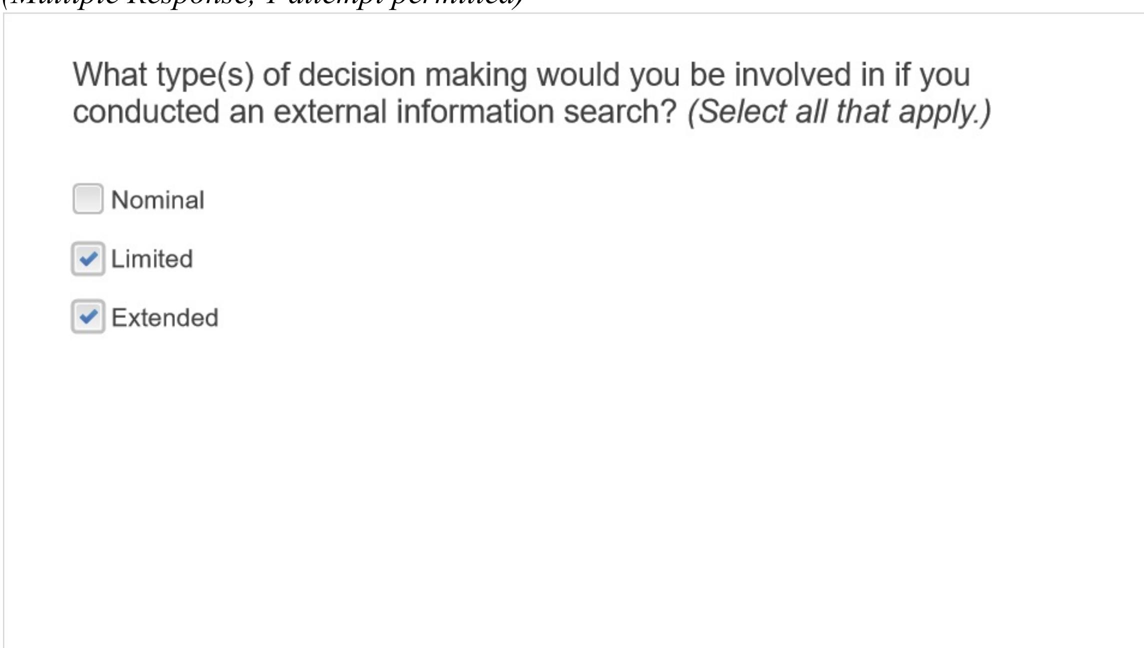


Correct	Choice
	You buy one brand of a certain product because it meets your needs.
	You have an enduring involvement with one brand and one product so you always buy it.
X	You buy one product and don't consider anything other than the product itself.

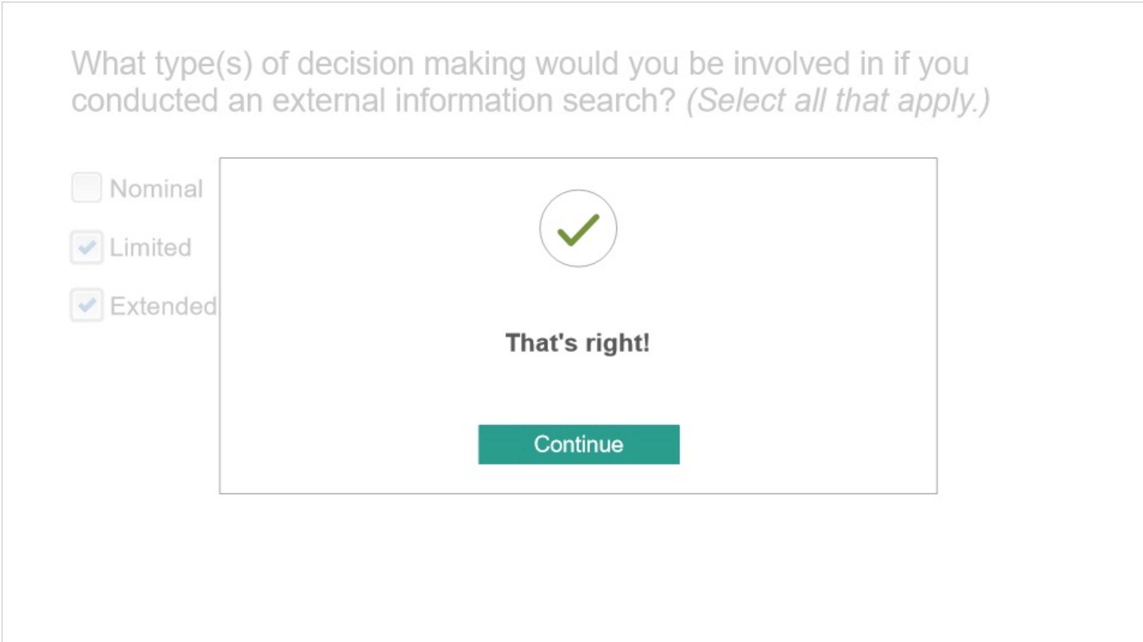


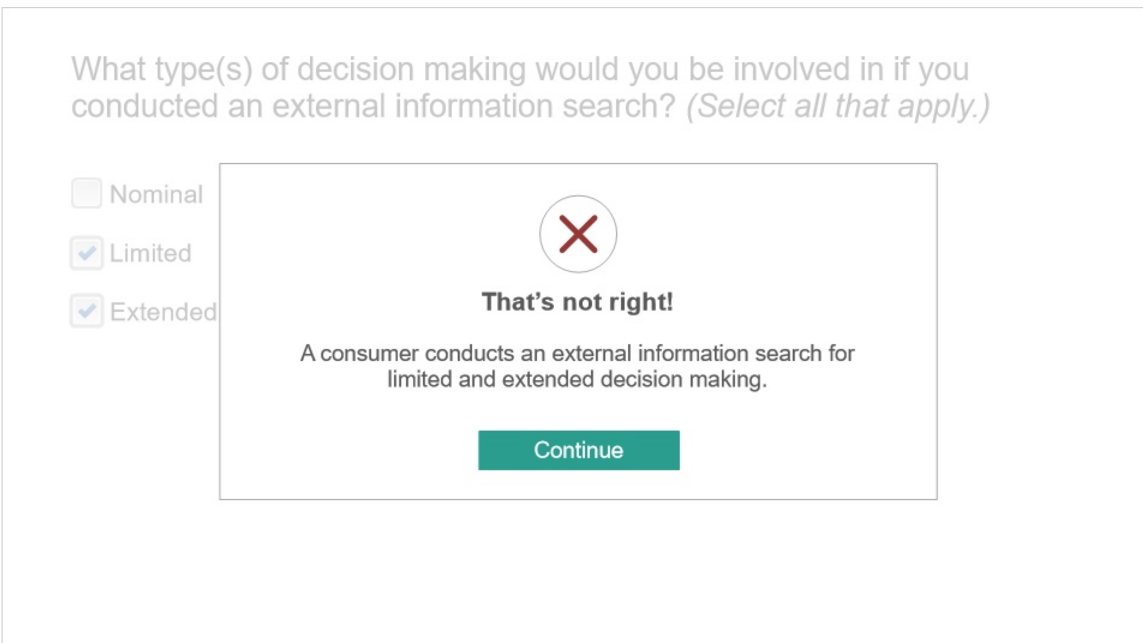


Review Question 2
(Multiple Response, 1 attempt permitted)

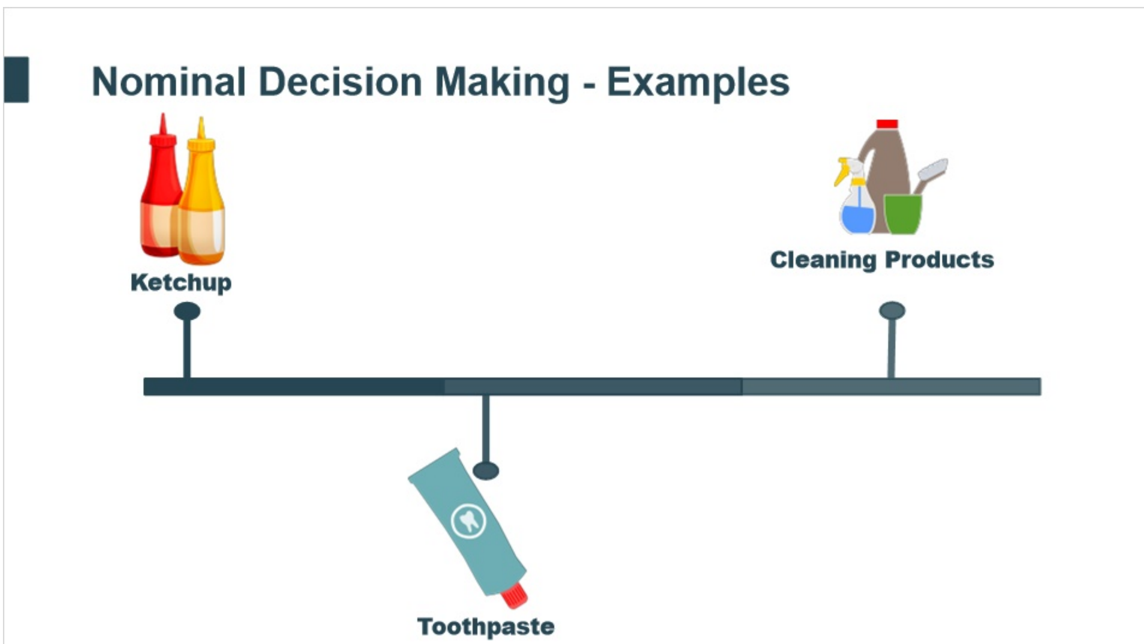


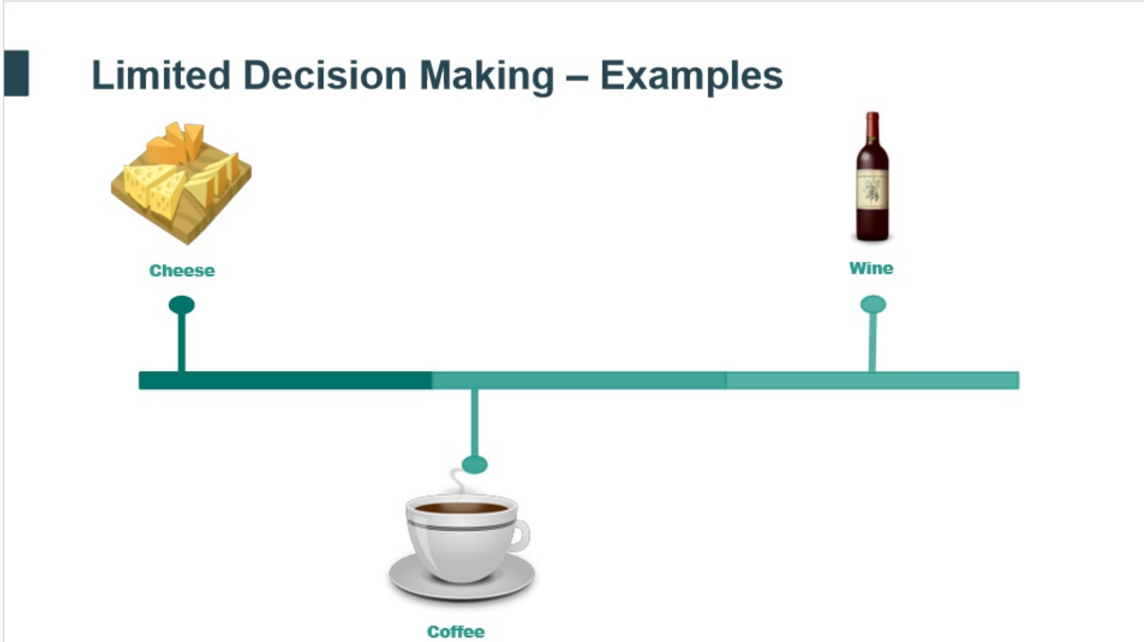
Correct	Choice
	Nominal
X	Limited
X	Extended

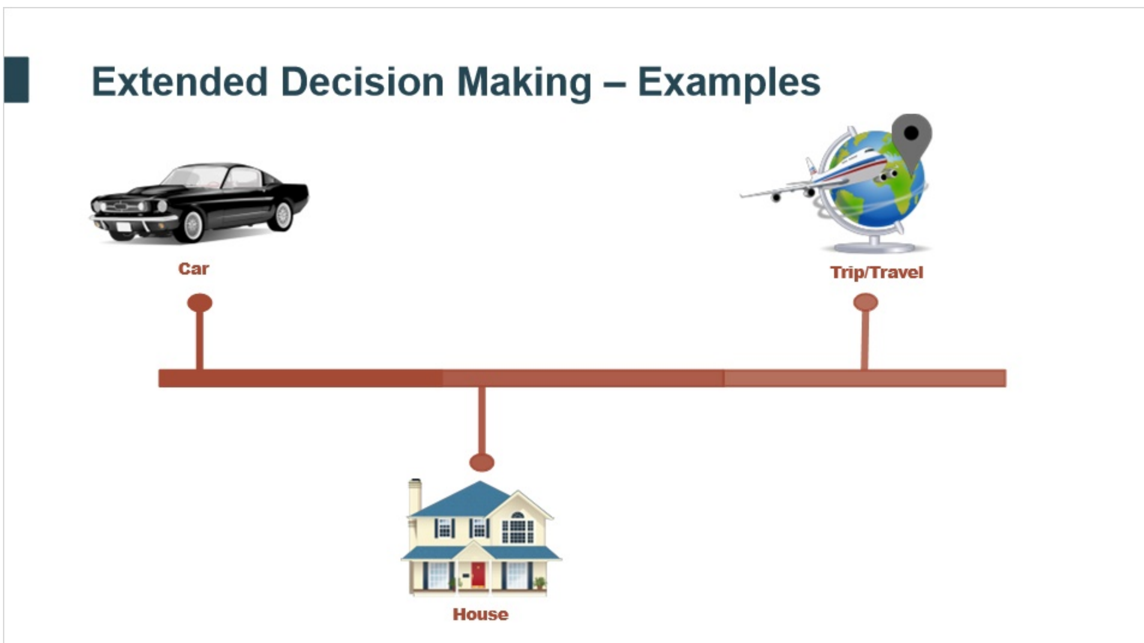

What type(s) of decision making would you be involved in if you conducted an external information search? (Select all that apply.)
Nominal
Limited
Extended
That's right!
Continue


What type(s) of decision making would you be involved in if you conducted an external information search? (Select all that apply.)
Nominal
Limited
Extended
That's not right!
A consumer conducts an external information search for limited and extended decision making.
Continue


Lesson 2
Examples


Nominal Decision Making - Examples
Ketchup
Cleaning Products
Toothpaste


Limited Decision Making – Examples
Cheese
Wine
Coffee


Extended Decision Making – Examples
Car
Trip/Travel
House

Summary

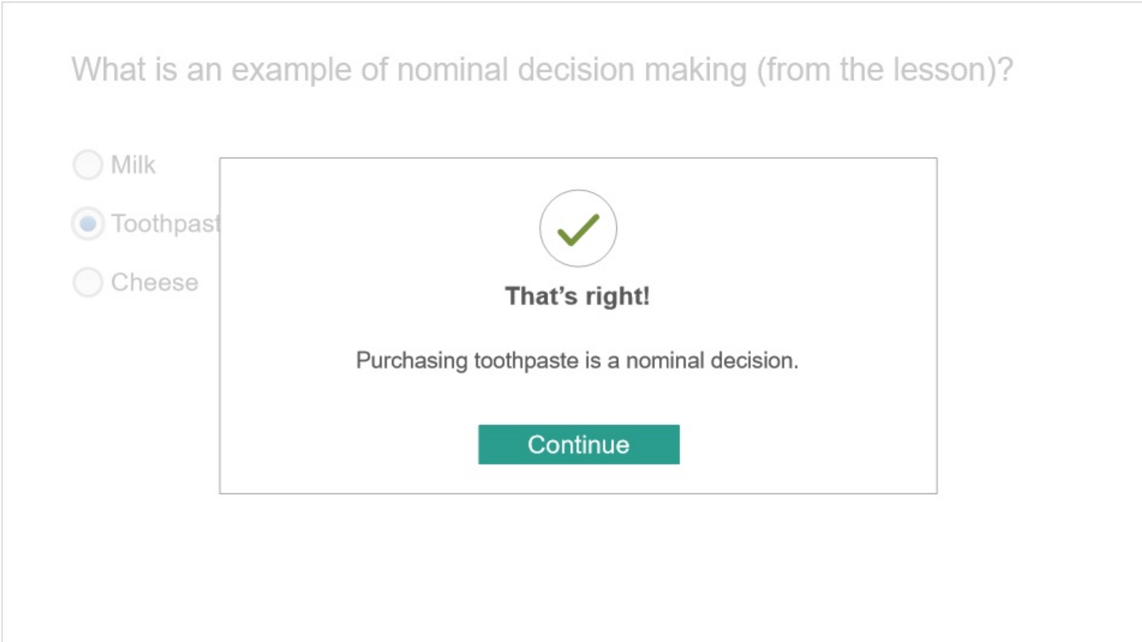
Type	Decision Making Process				
	Problem Recognition	Information Search	Alternative Evaluation	Purchase	Post Purchase
Nominal	Selective	Limited internal	None	Low involvement	• No dissonance • Very limited evaluation
Limited	Generic	• Internal • Limited external	• Few attributes • Simple decision rules • Few alternatives	Medium involvement	• No dissonance • Limited evaluation
Extended	Generic	• Internal • External	• Many attributes • Complex decisions rules • Many alternatives	High involvement	• Dissonance • Complex evaluation

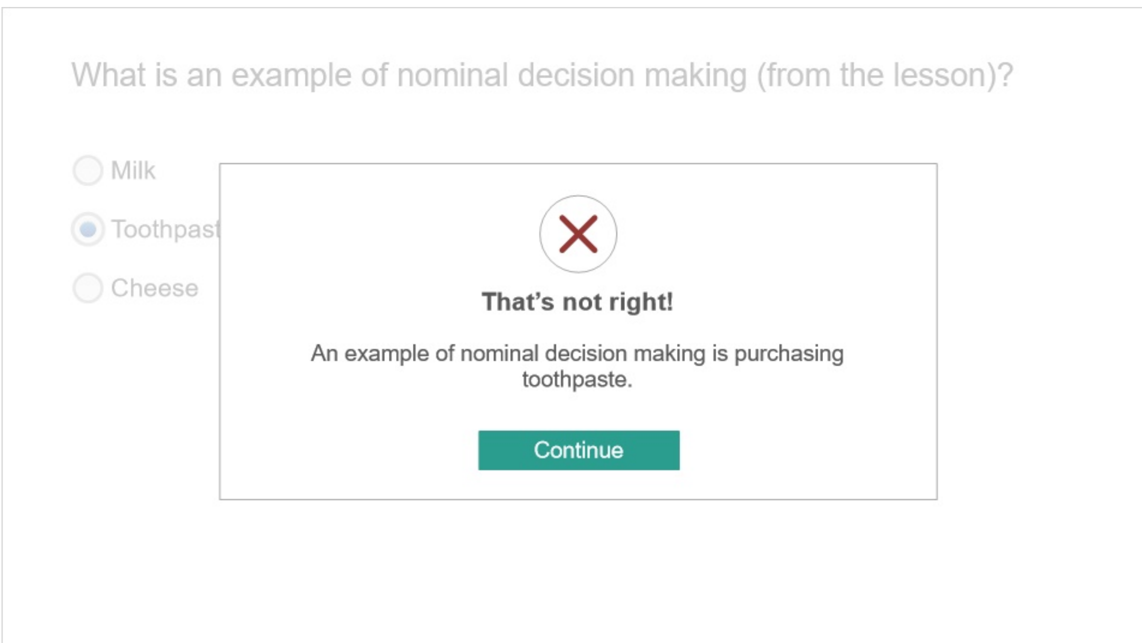
Review Question 3
(Multiple Choice, 1 attempt permitted)

What is an example of nominal decision making (from the lesson)?

- Milk
- Toothpaste
- Cheese

Correct	Choice
	Milk
X	Toothpaste
	Cheese


What is an example of nominal decision making (from the lesson)?
Milk
Toothpast
Cheese
That's right!
Purchasing toothpaste is a nominal decision.
Continue

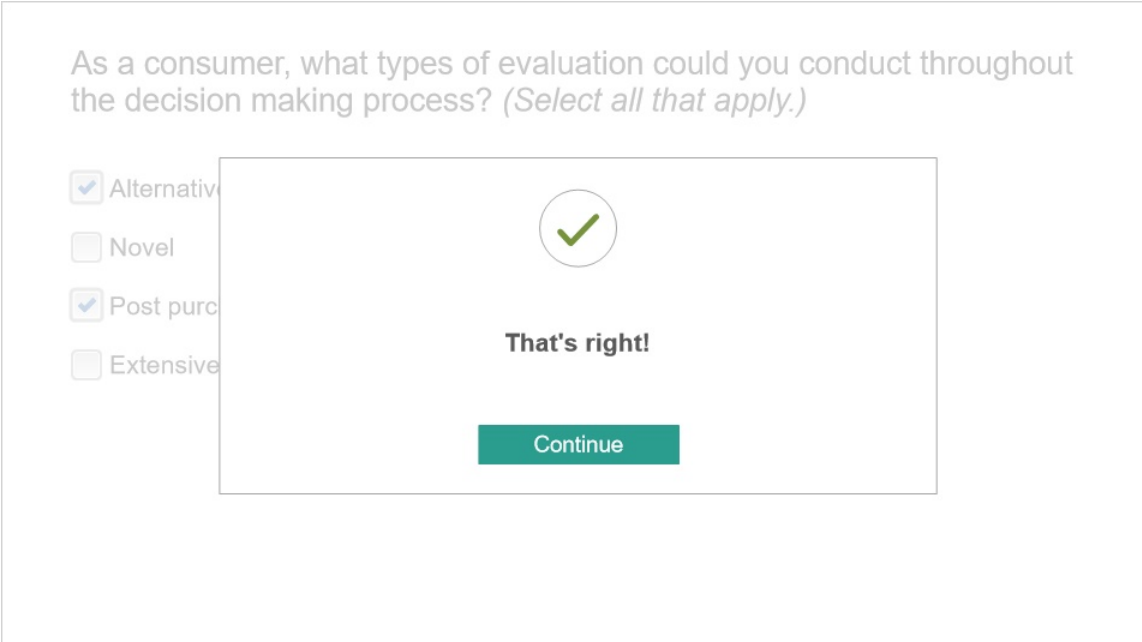

What is an example of nominal decision making (from the lesson)?
Milk
Toothpast
Cheese
That's not right!
An example of nominal decision making is purchasing toothpaste.
Continue

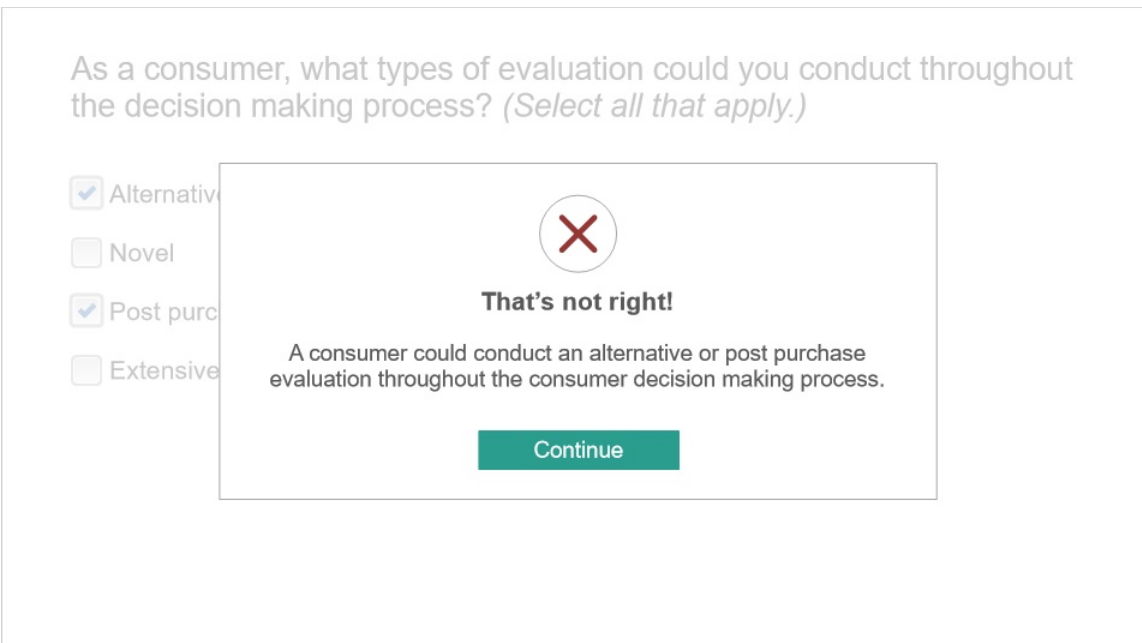
Review Question 4
(Multiple Response, 1 attempt permitted)

As a consumer, what types of evaluation could you conduct throughout the decision making process? *(Select all that apply.)*

- [x] Alternative
- [ ] Novel
- [x] Post purchase
- [ ] Extensive

Correct	Choice
X	Alternative
	Novel
X	Post purchase
	Extensive


As a consumer, what types of evaluation could you conduct throughout the decision making process? (Select all that apply.)
Alternativ
Novel
Post purc
Extensive
That's right!
Continue


As a consumer, what types of evaluation could you conduct throughout the decision making process? (Select all that apply.)
Alternativ
Novel
Post purc
Extensive
That's not right!
A consumer could conduct an alternative or post purchase evaluation throughout the consumer decision making process.
Continue

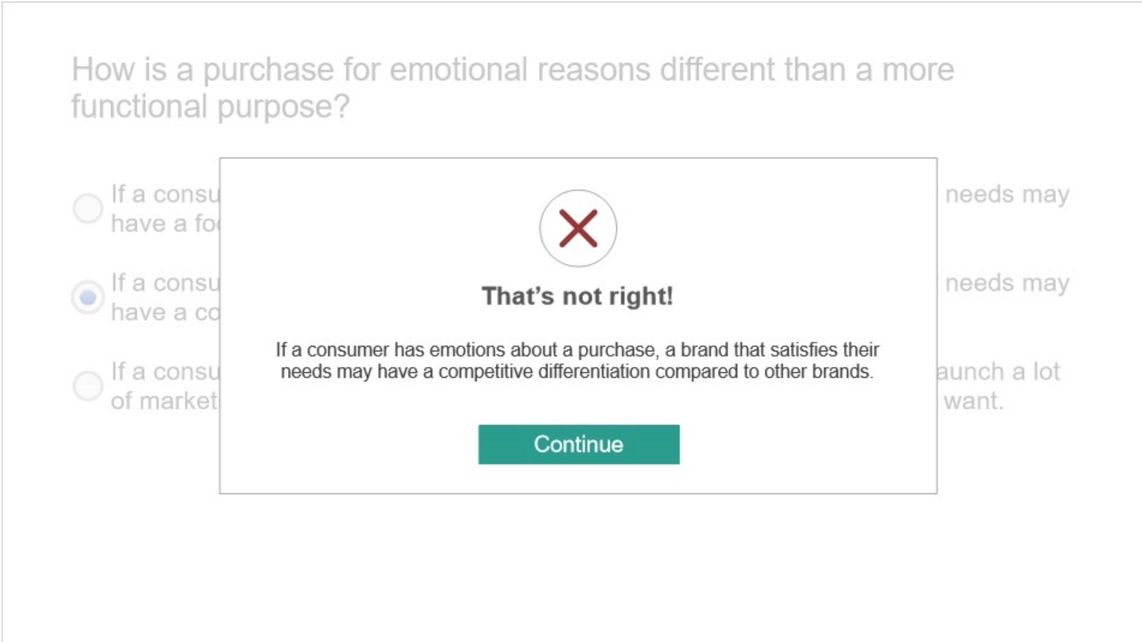
Review Question 5

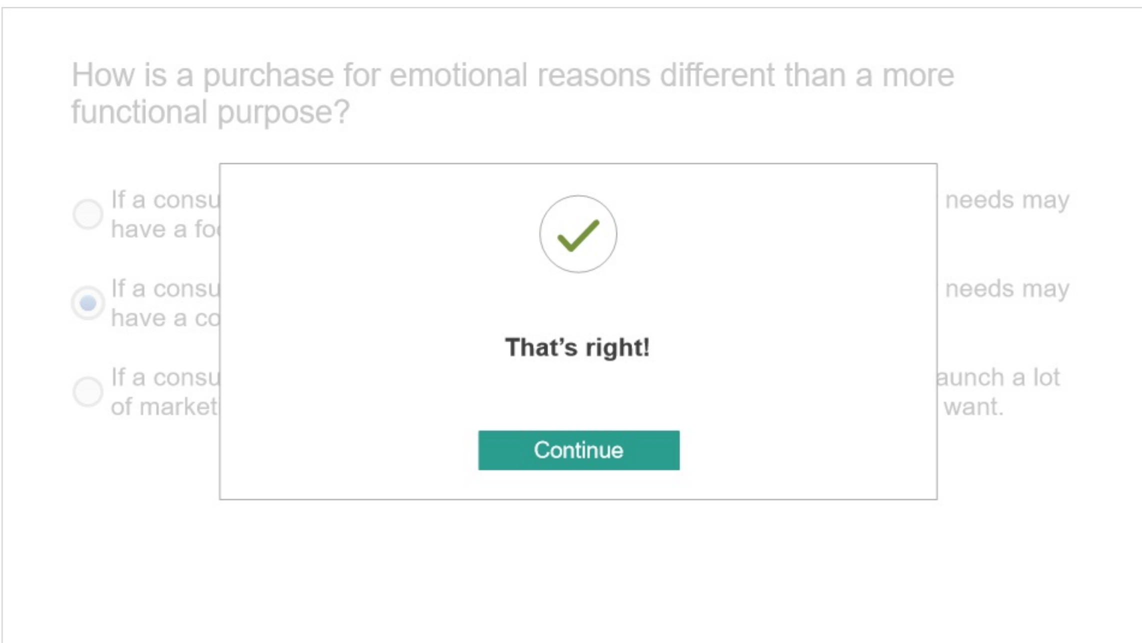
(Multiple Choice, 1 attempt permitted)

How is a purchase for emotional reasons different than a more functional purpose?

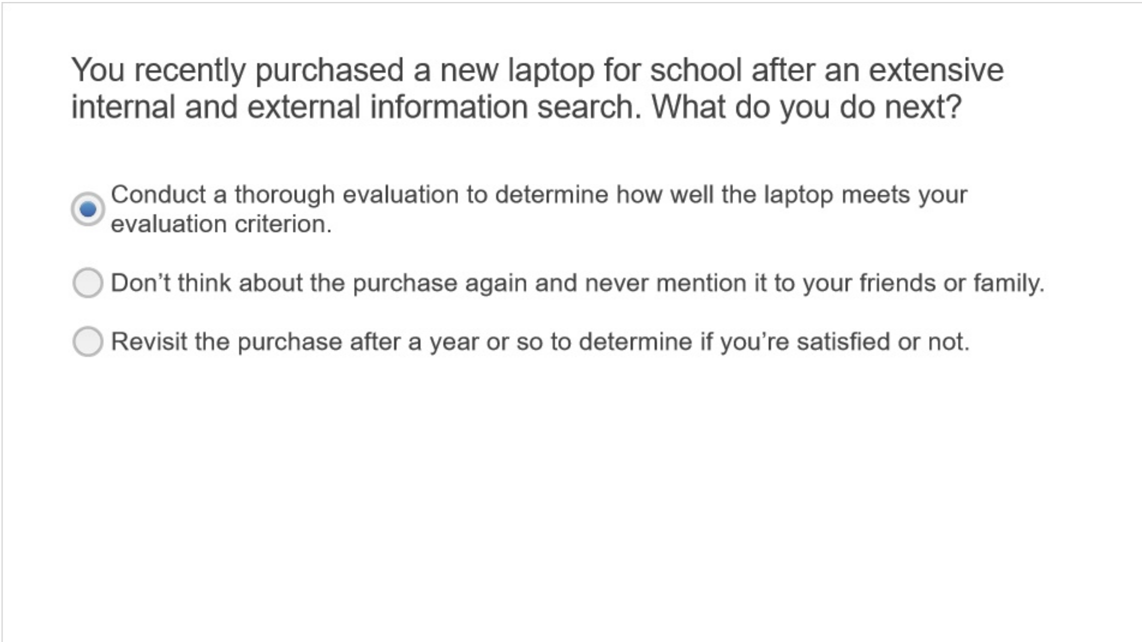
- ( ) If a consumer has emotions about a purchase, a brand that satisfies their needs may have a foot in the door because of product credibility.
- (•) If a consumer has emotions about a purchase, a brand that satisfies their needs may have a competitive differentiation compared to other brands.
- ( ) If a consumer has emotions about a purchase, a brand may not need to launch a lot of marketing campaigns because the consumer already knows what they want.

Correct	Choice
	If a consumer has emotions about a purchase, a brand that satisfies their needs may have a foot in the door because of product credibility.
X	If a consumer has emotions about a purchase, a brand that satisfies their needs may have a competitive differentiation compared to other brands.
	If a consumer has emotions about a purchase, a brand may not need to launch a lot of marketing campaigns because the consumer already knows what they want.

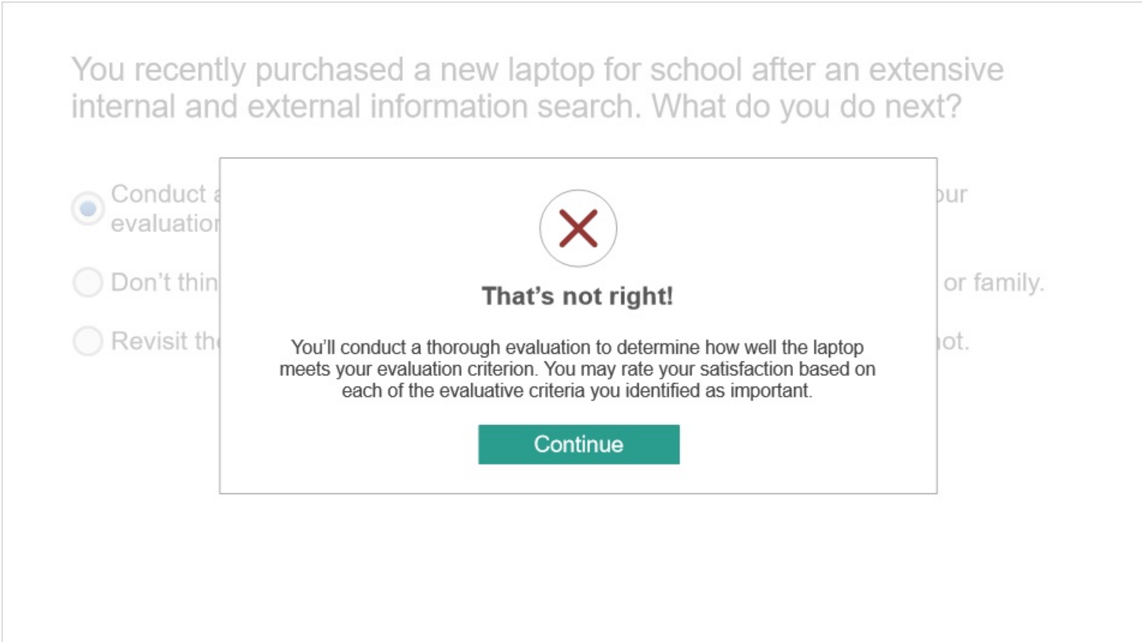

How is a purchase for emotional reasons different than a more functional purpose?
That's not right!
If a consumer has emotions about a purchase, a brand that satisfies their needs may have a competitive differentiation compared to other brands.
Continue

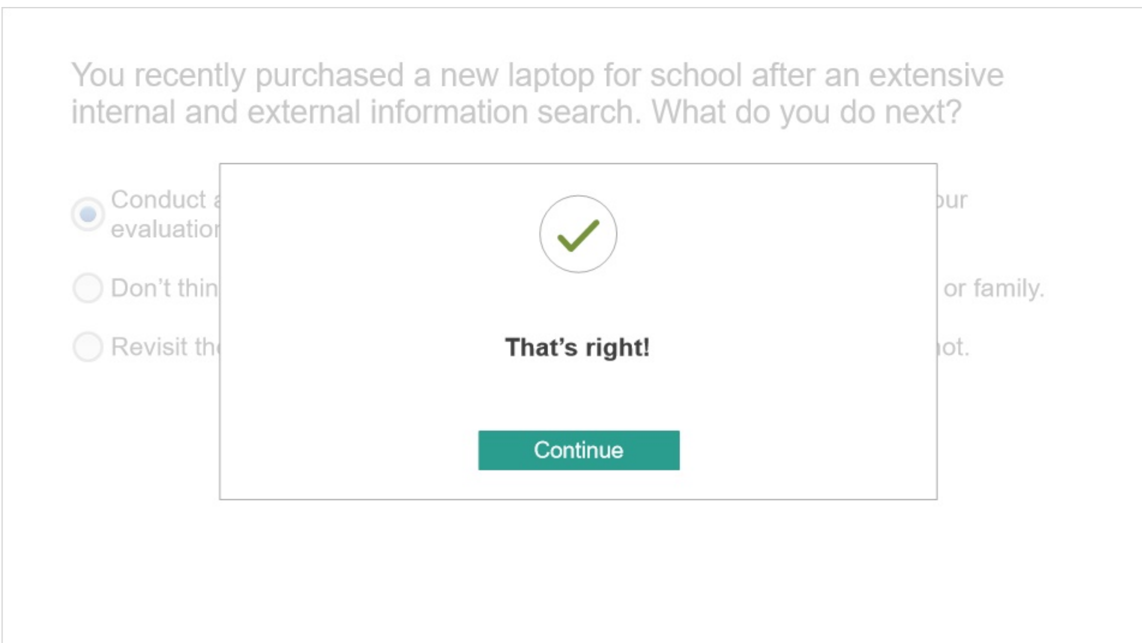

How is a purchase for emotional reasons different than a more functional purpose?
That's right!
Continue

Review Question 6
(Multiple Choice, 1 attempt permitted)

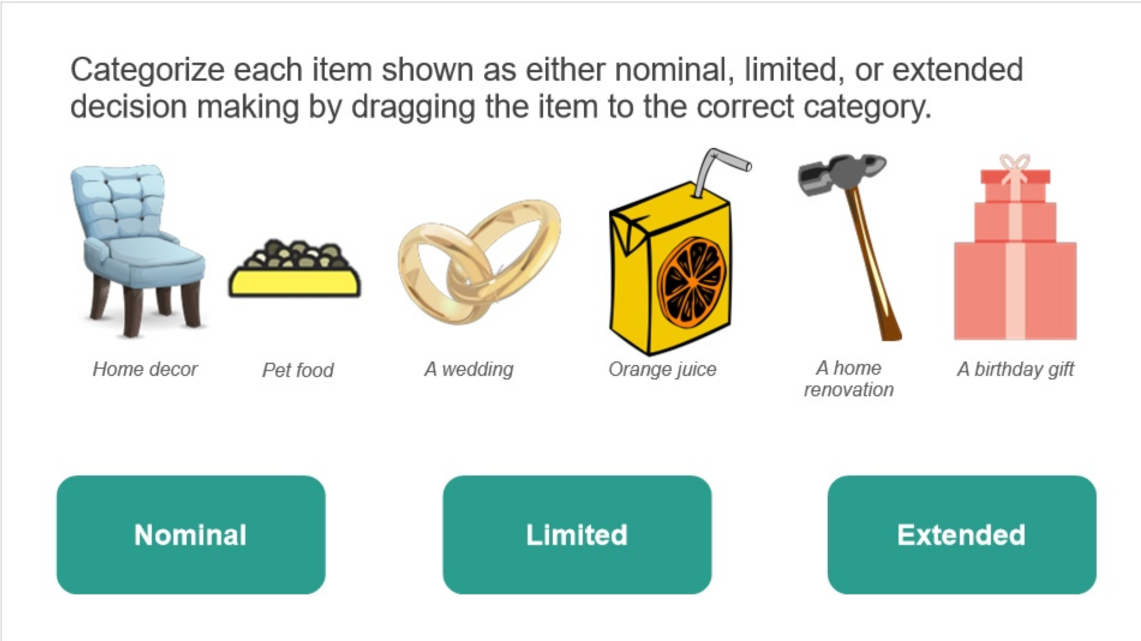


Correct	Choice
X	Conduct a thorough evaluation to determine how well the laptop meets your evaluation criterion.
	Don’t think about the purchase again and never mention it to your friends or family.
	Revisit the purchase after a year or so to determine if you’re satisfied or not.


You recently purchased a new laptop for school after an extensive internal and external information search. What do you do next?
That's not right!
You'll conduct a thorough evaluation to determine how well the laptop meets your evaluation criterion. You may rate your satisfaction based on each of the evaluative criteria you identified as important.
Continue

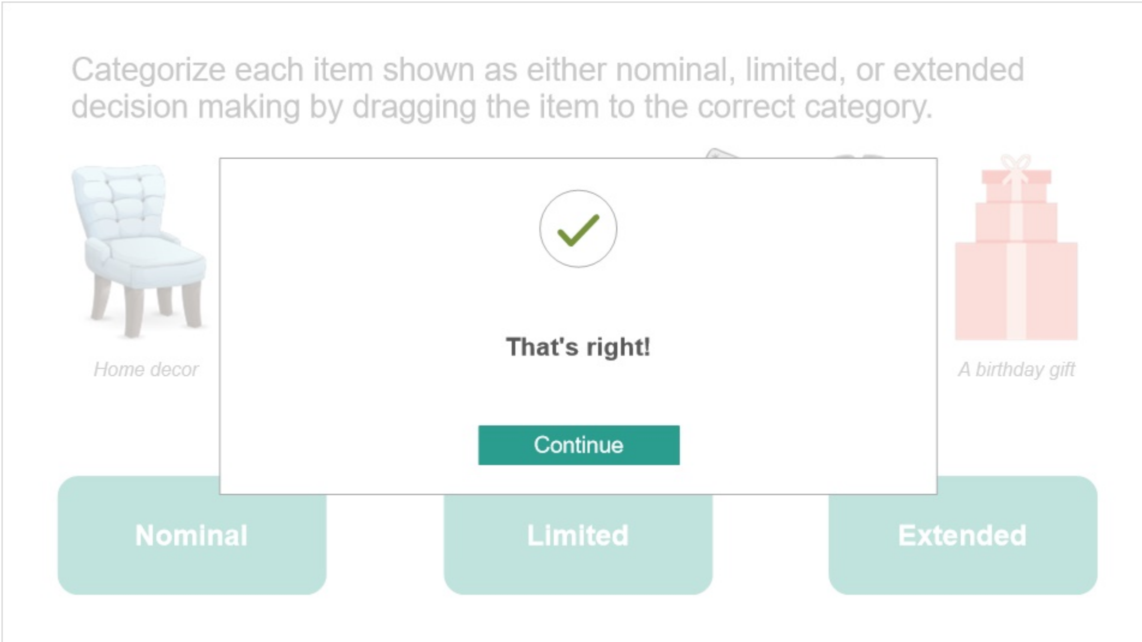

You recently purchased a new laptop for school after an extensive internal and external information search. What do you do next?
That's right!
Continue

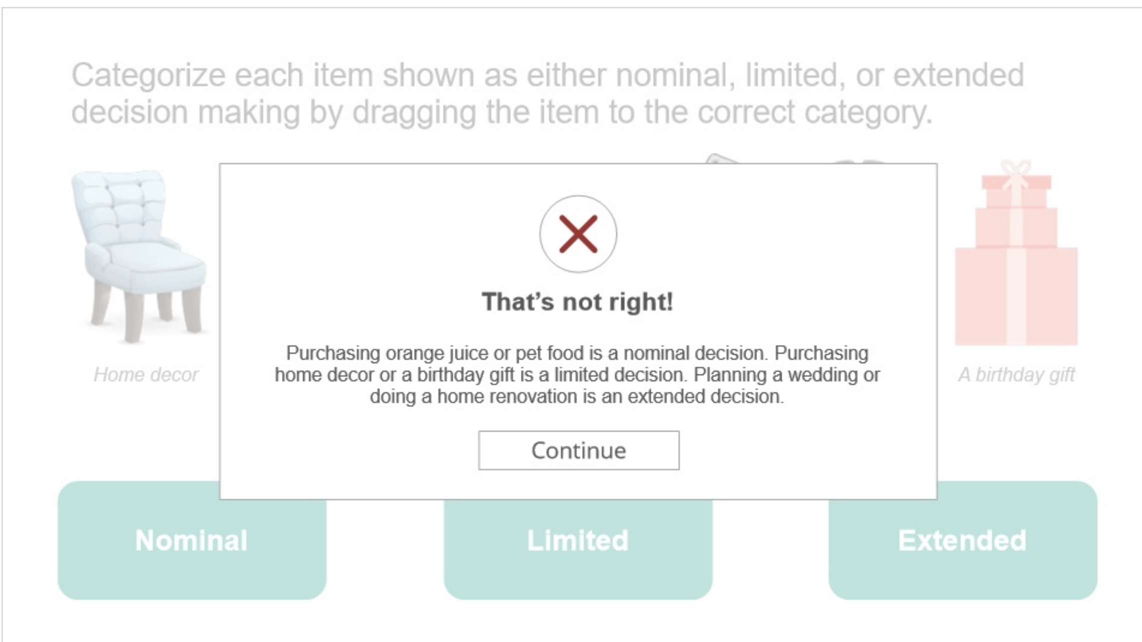
Review Question 7
(Drag and drop, 1 attempt permitted)



Drag Item	Drop Target
orange juice	Nominal
wedding	Extended
home decor	Limited
pet food	Nominal
home reno	Extended
bday gift	Limited

Drag and drop properties
Snap dropped items to drop target (Stack random)
Delay item drop states until interaction is submitted


Categorize each item shown as either nominal, limited, or extended decision making by dragging the item to the correct category.
Home decor
A birthday gift
That's right!
Continue
Nominal
Limited
Extended


Categorize each item shown as either nominal, limited, or extended decision making by dragging the item to the correct category.
Home decor
A birthday gift
That's not right!
Purchasing orange juice or pet food is a nominal decision. Purchasing home decor or a birthday gift is a limited decision. Planning a wedding or doing a home renovation is an extended decision.
Continue
Nominal
Limited
Extended

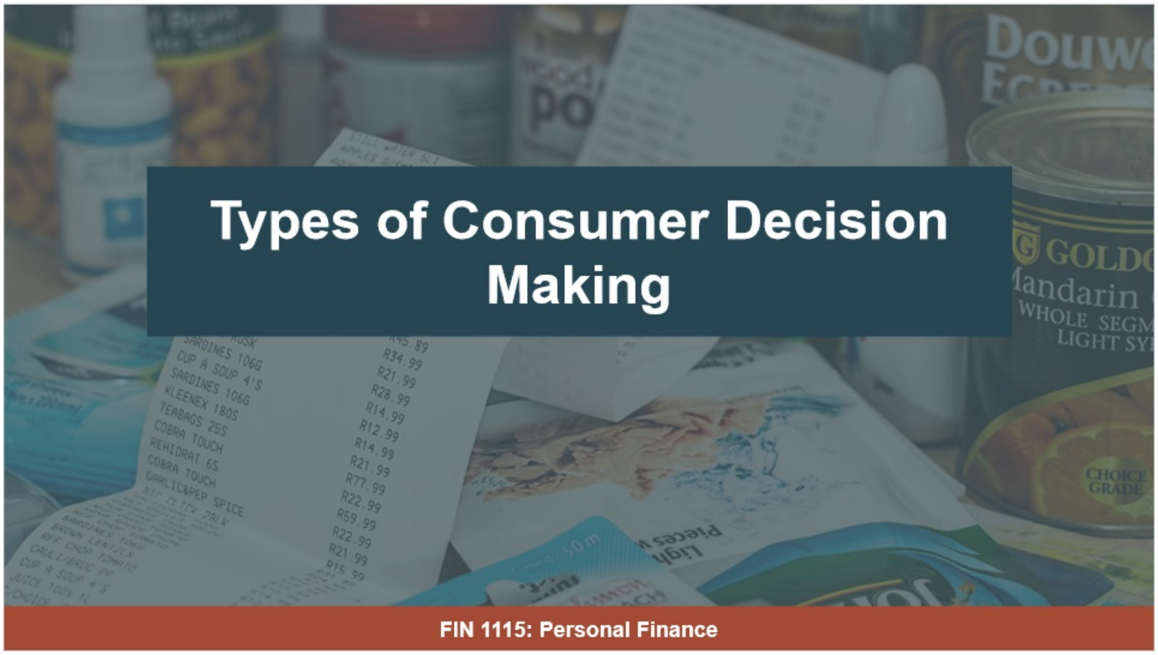
Module Complete!

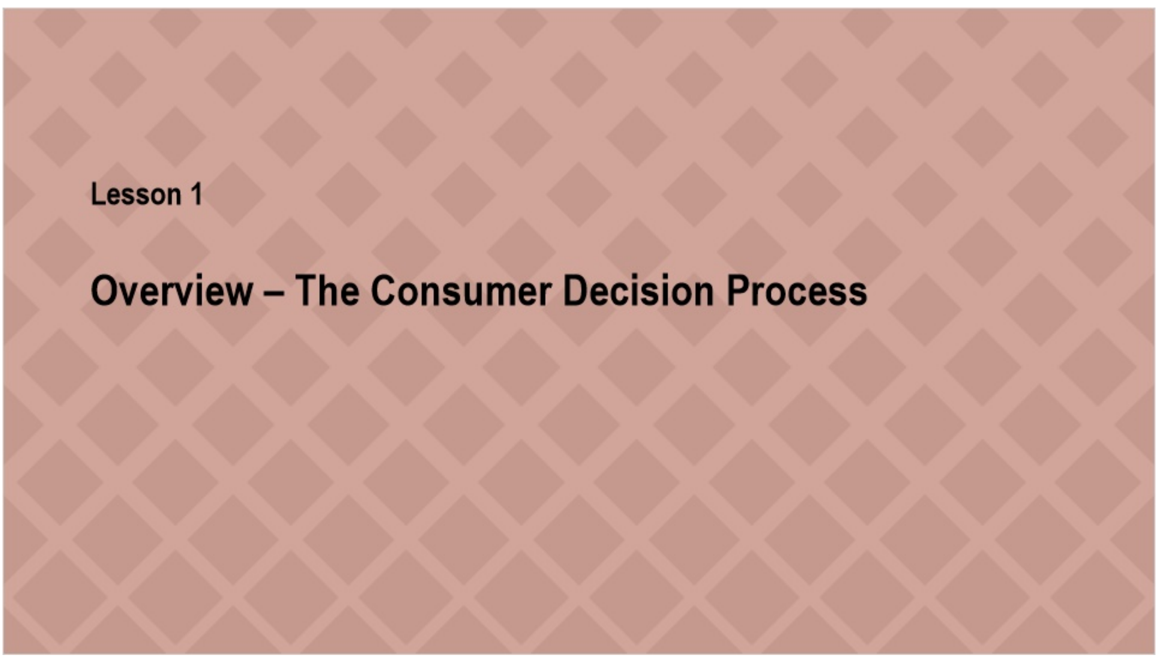
Exit this module by clicking the button below.

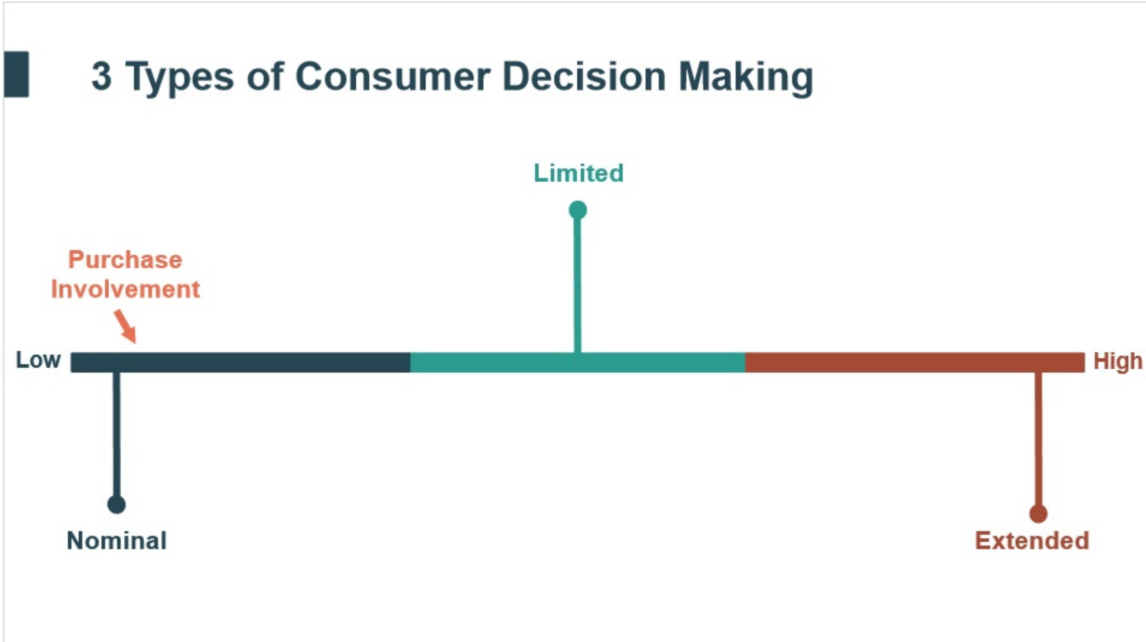
Once you exit, go back to the course page on Moodle and **complete the posttest** under this week's course materials.

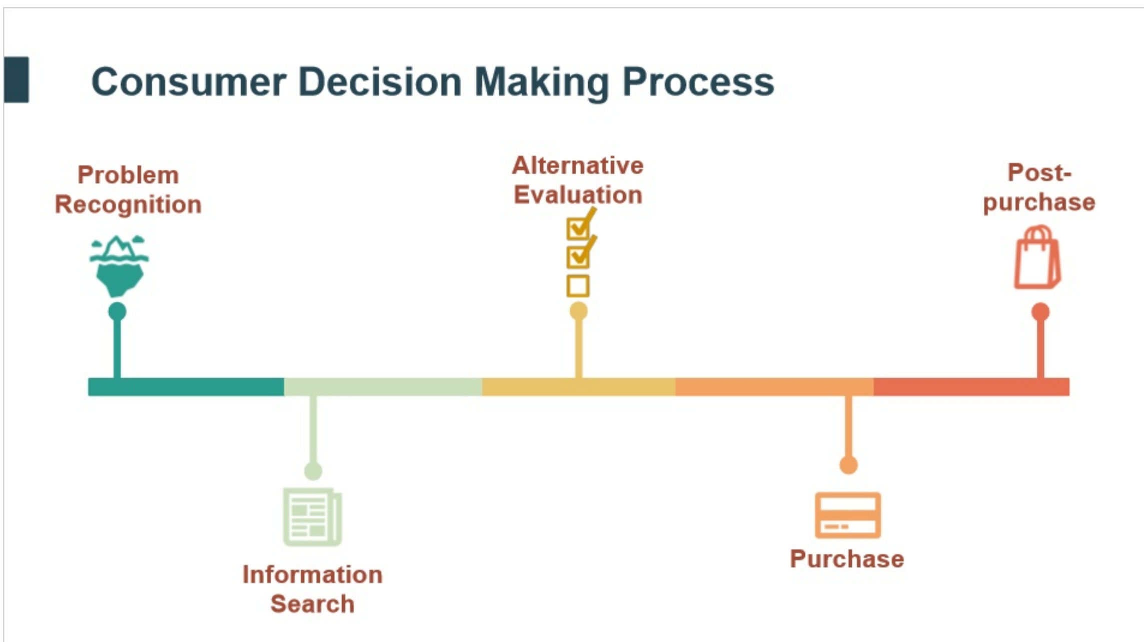
Exit Module

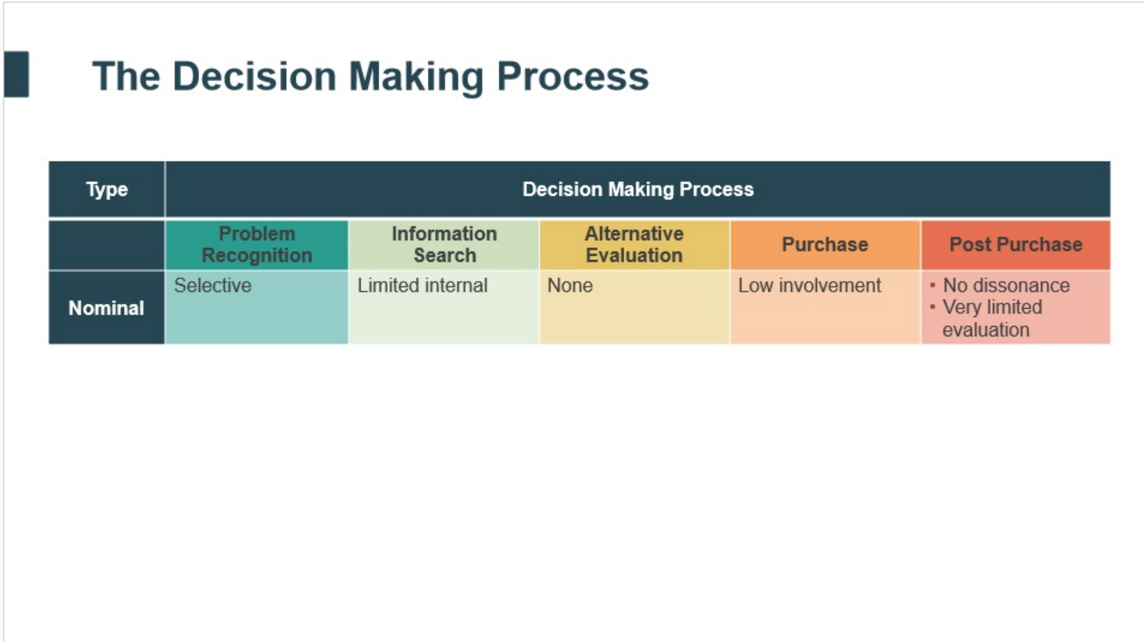
Segmenting – Pretraining (PSM Treatment)






3 Types of Consumer Decision Making
Limited
Purchase Involvement
Low
High
Nominal
Extended

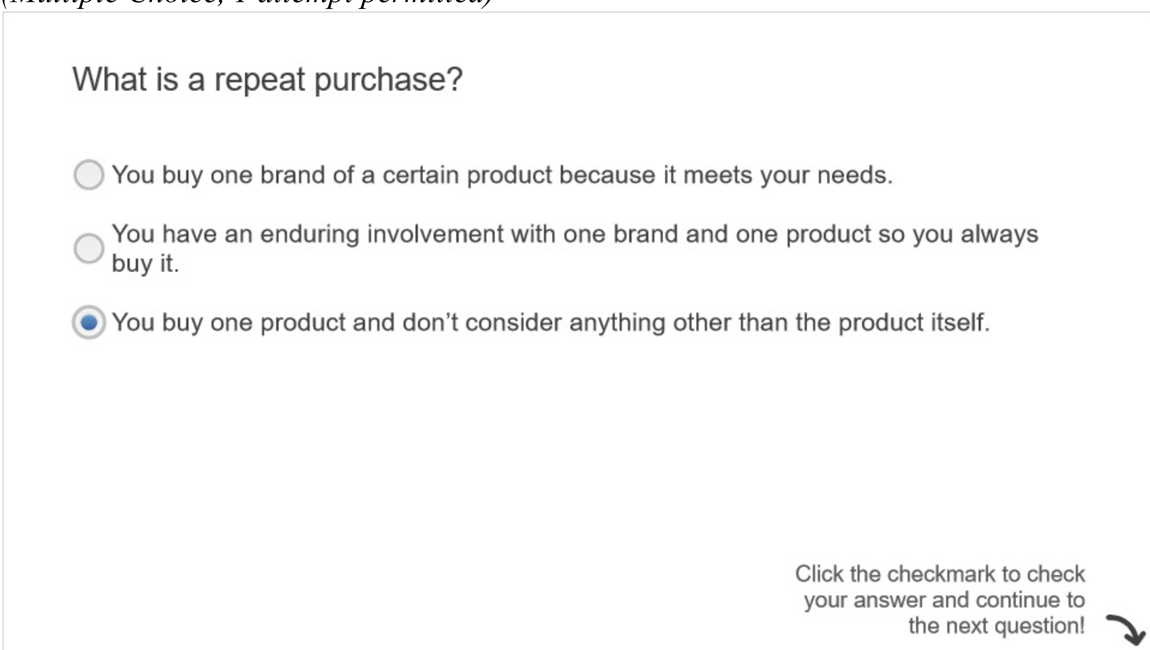

Consumer Decision Making Process
Problem Recognition
Alternative Evaluation
Post-purchase
Information Search
Purchase



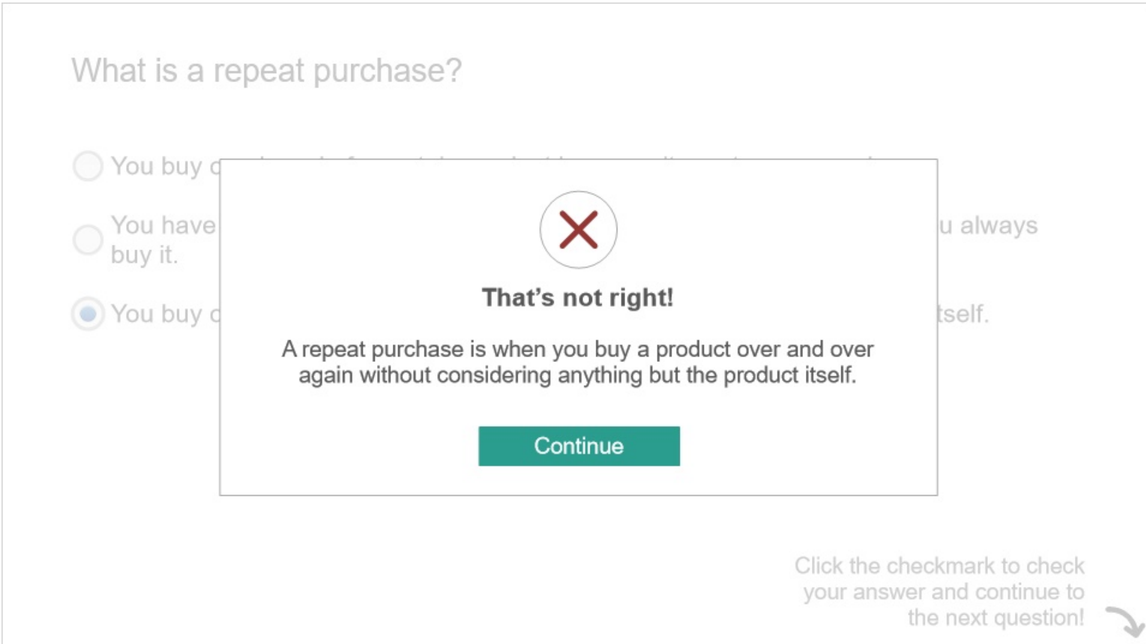
The Decision Making Process

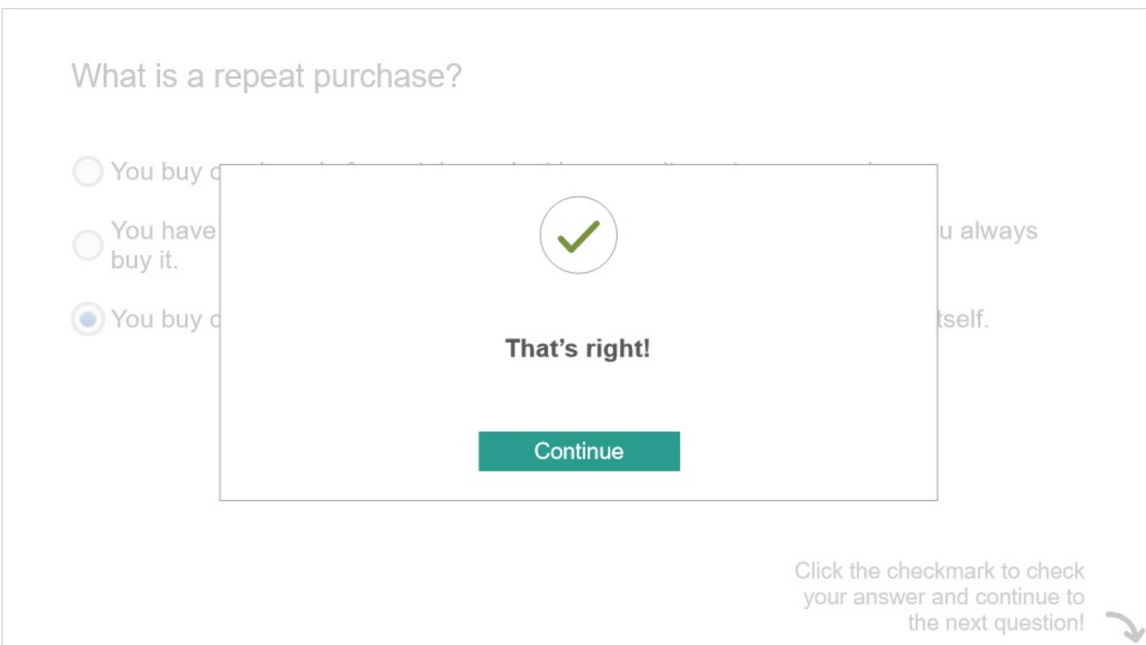
Type	Decision Making Process				
	Problem Recognition	Information Search	Alternative Evaluation	Purchase	Post Purchase
Nominal	Selective	Limited internal	None	Low involvement	• No dissonance • Very limited evaluation

Review Question 1
(Multiple Choice, 1 attempt permitted)

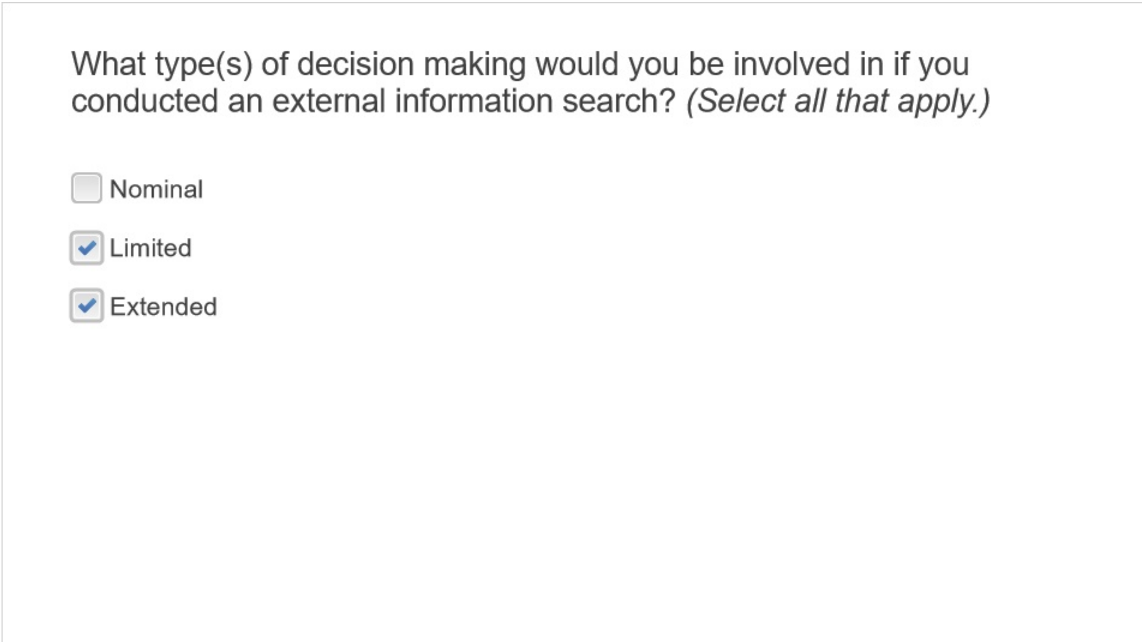


Correct	Choice
	You buy one brand of a certain product because it meets your needs.
	You have an enduring involvement with one brand and one product so you always buy it.
X	You buy one product and don't consider anything other than the product itself.

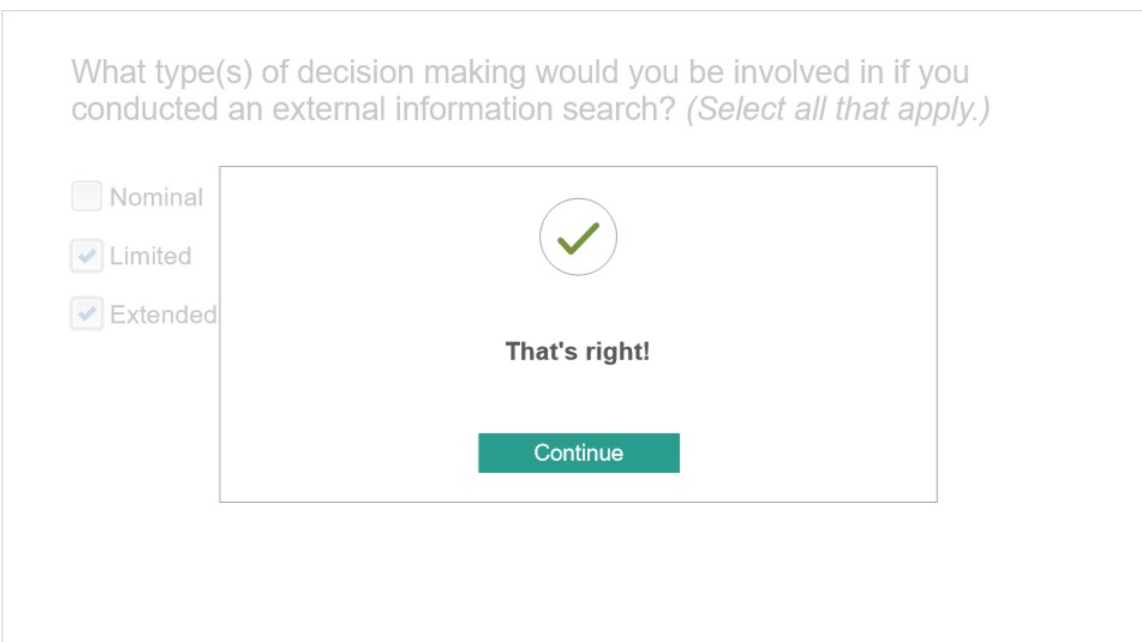

What is a repeat purchase?
You buy c
You have
buy it.
u always
You buy c
tself.
That’s not right!
A repeat purchase is when you buy a product over and over again without considering anything but the product itself.
Continue
Click the checkmark to check your answer and continue to the next question!


What is a repeat purchase?
You buy c
You have
buy it.
u always
You buy c
tself.
That’s right!
Continue
Click the checkmark to check your answer and continue to the next question!

Review Question 2
(Multiple Response, 1 attempt permitted)



Correct	Choice
	Nominal
X	Limited
X	Extended



What type(s) of decision making would you be involved in if you conducted an external information search? *(Select all that apply.)*

- [ ] Nominal
- [x] Limited
- [x] Extended

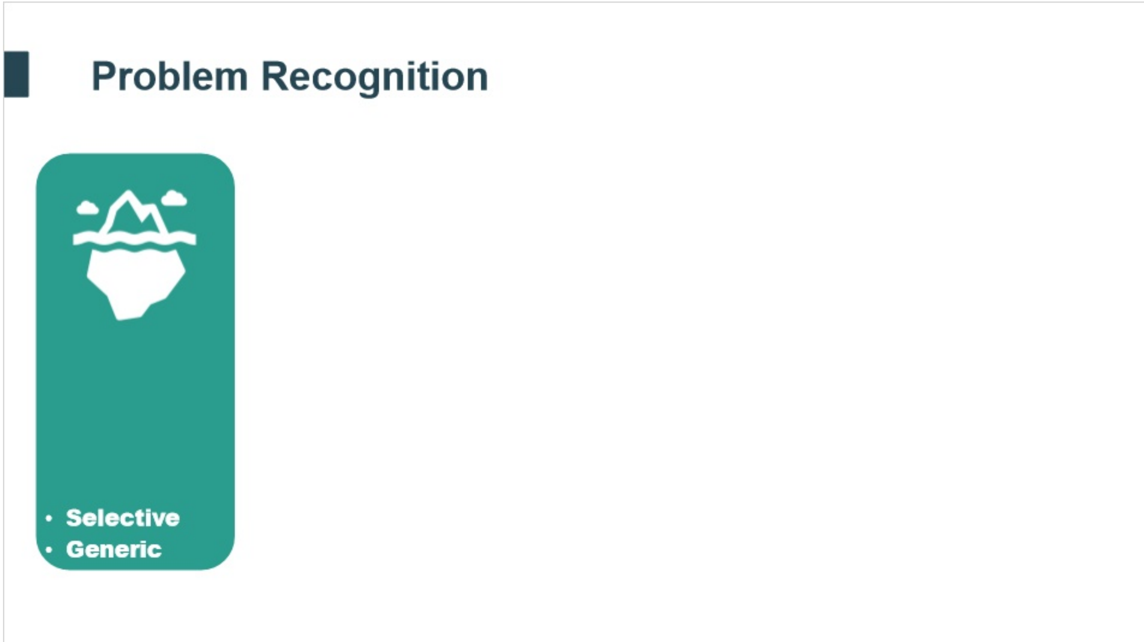
That's not right!

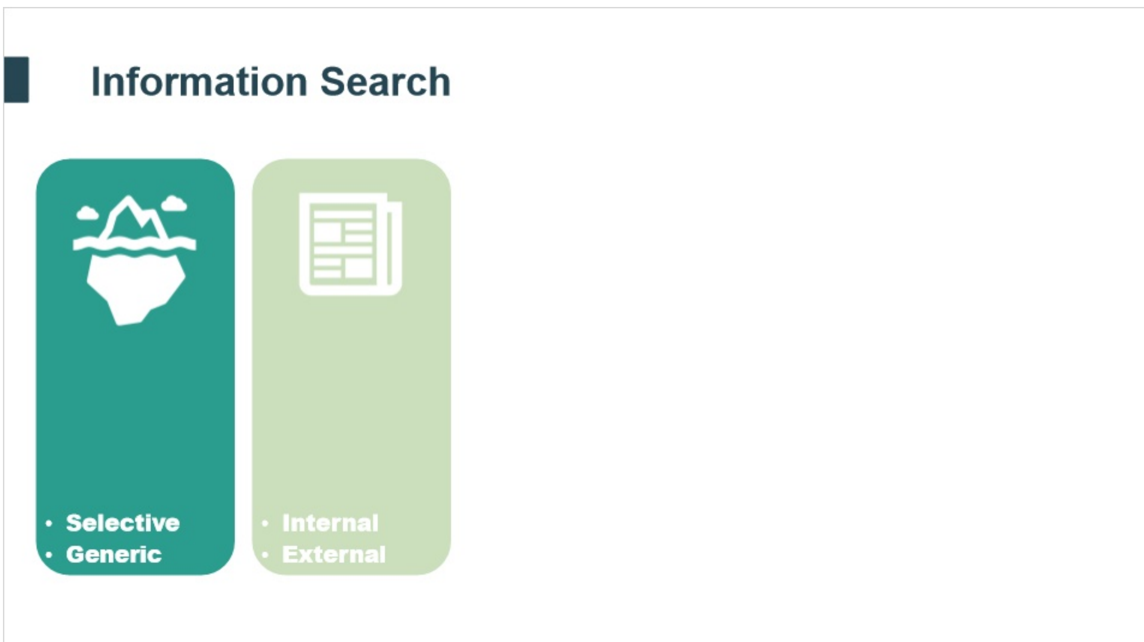
A consumer conducts an external information search for limited and extended decision making.

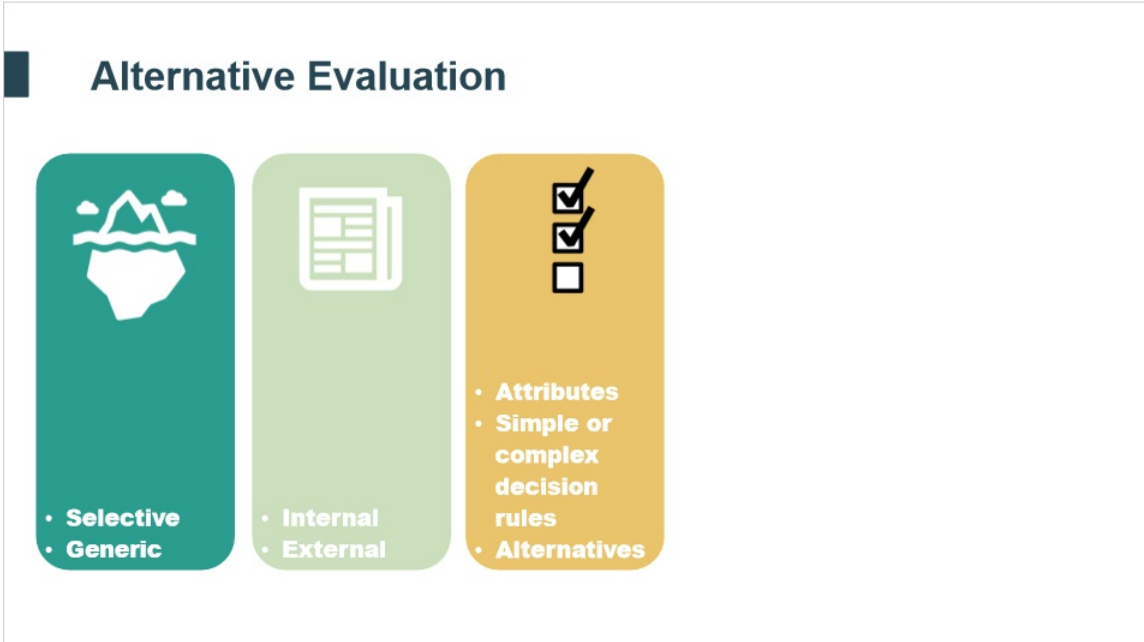
Continue

Lesson 2

Types of Decision Making

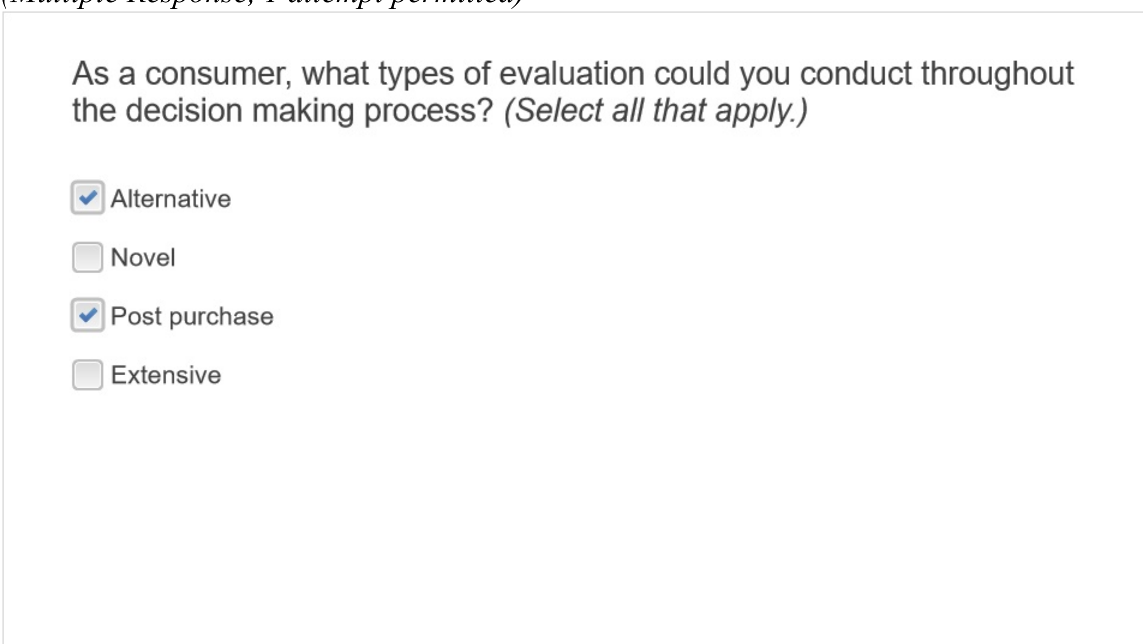

Problem Recognition
• Selective
• Generic


Information Search
• Selective
• Generic
• Internal
• External

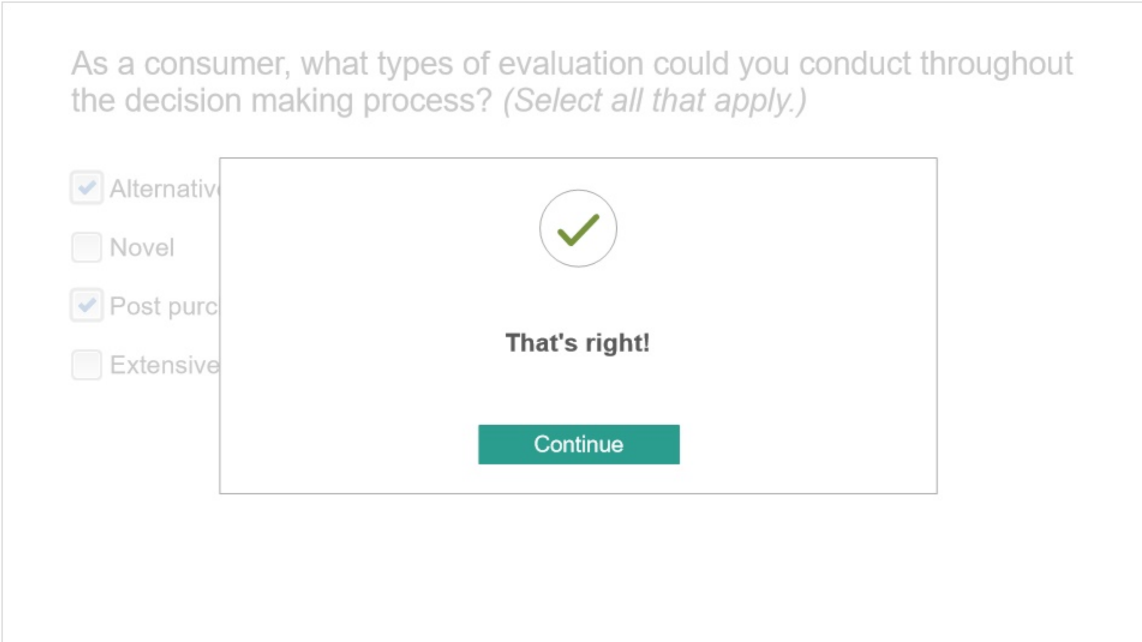

Alternative Evaluation
• Selective
• Generic
• Internal
• External
• Attributes
• Simple or complex decision rules
• Alternatives

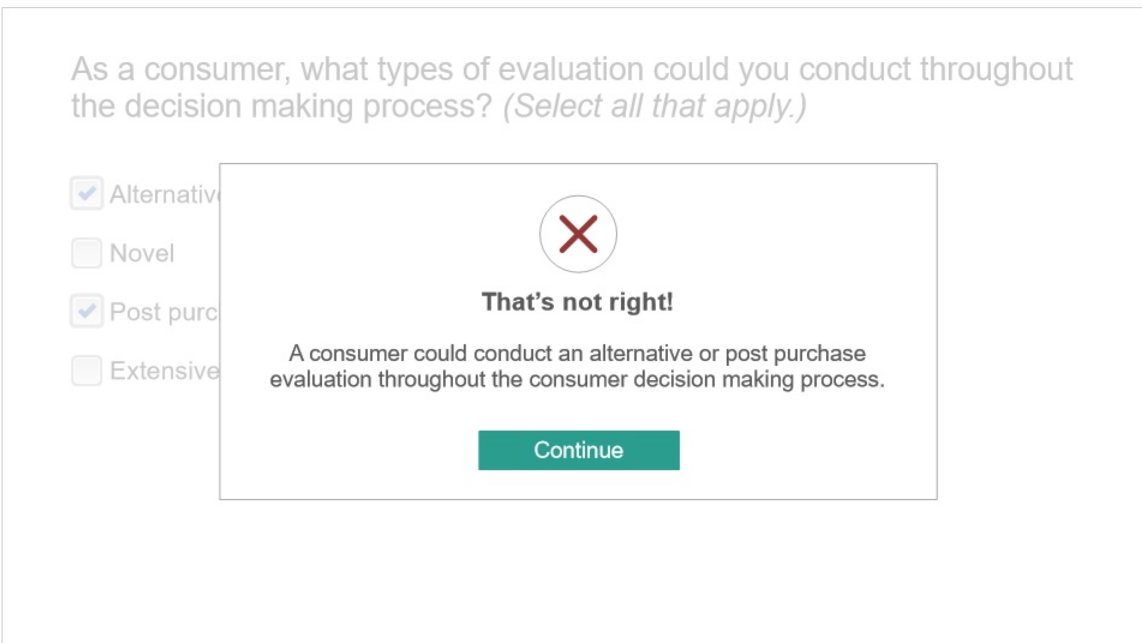

Purchase
• Selective
• Generic
• Internal
• External
• Many attributes
• Simple or complex decision rules
• Many alternatives
• Low to high involvement

Review Question 3
(Multiple Response, 1 attempt permitted)



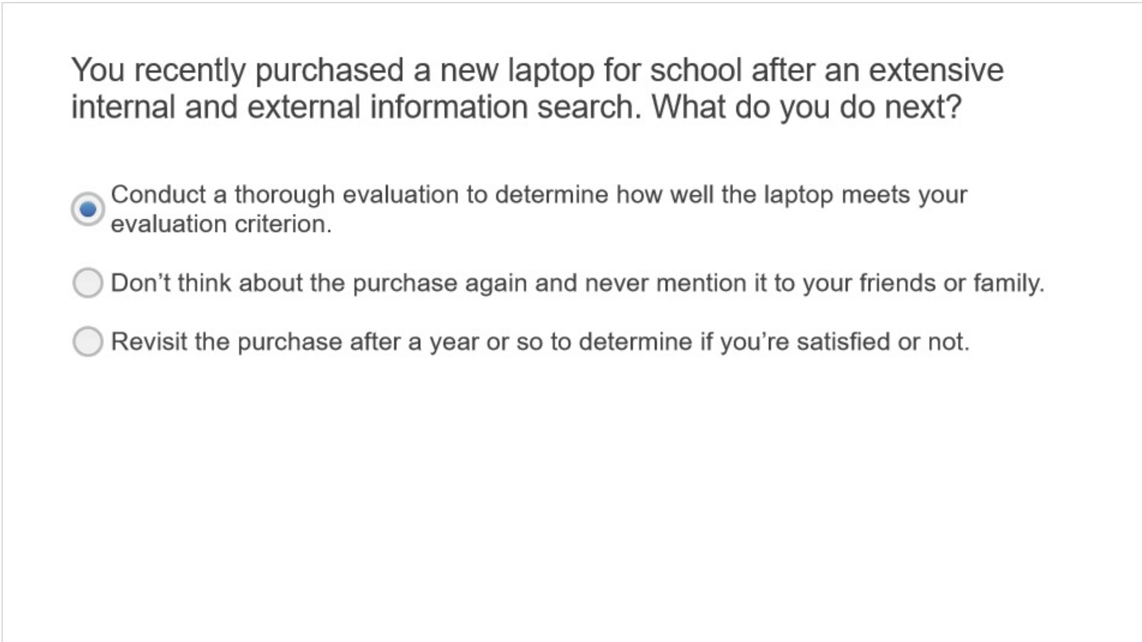
Correct	Choice
X	Alternative
	Novel
X	Post purchase
	Extensive


As a consumer, what types of evaluation could you conduct throughout the decision making process? *(Select all that apply.)*
Alternativ
Novel
Post purc
Extensive
That's right!
Continue

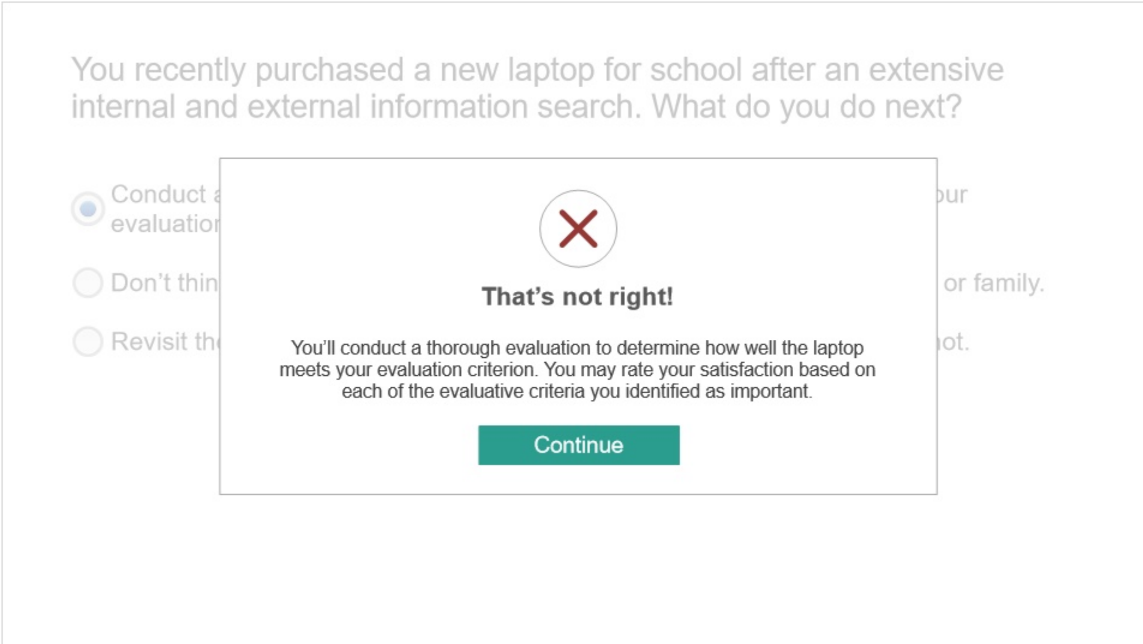

As a consumer, what types of evaluation could you conduct throughout the decision making process? *(Select all that apply.)*
Alternativ
Novel
Post purc
Extensive
That's not right!
A consumer could conduct an alternative or post purchase evaluation throughout the consumer decision making process.
Continue

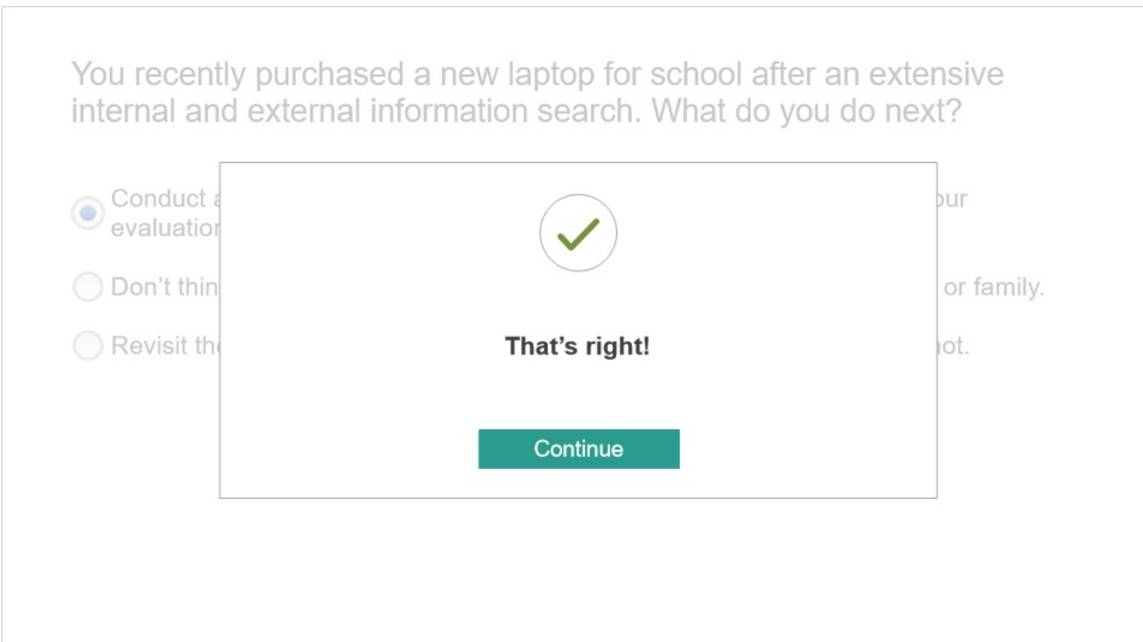
Review Question 4

(Multiple Choice, 1 attempt permitted)



Correct	Choice
X	Conduct a thorough evaluation to determine how well the laptop meets your evaluation criterion.
	Don't think about the purchase again and never mention it to your friends or family.
	Revisit the purchase after a year or so to determine if you're satisfied or not.

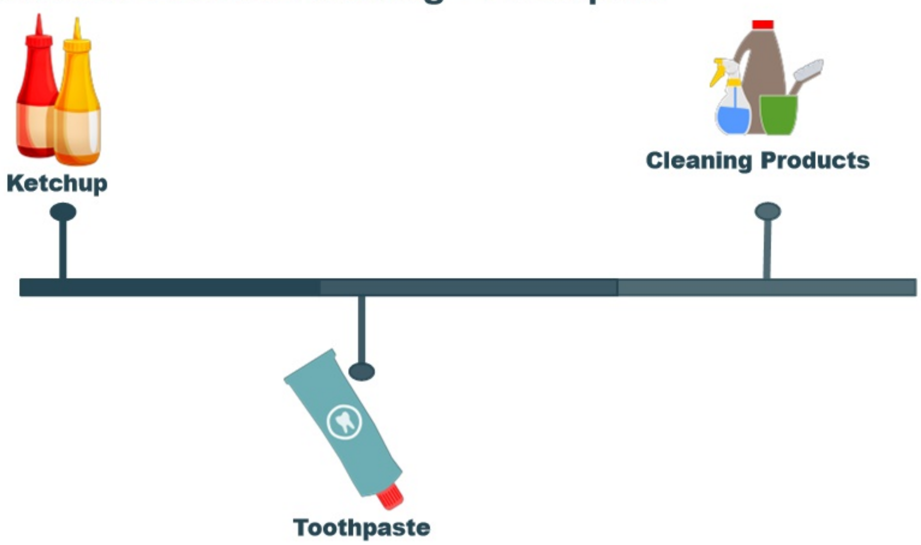

You recently purchased a new laptop for school after an extensive internal and external information search. What do you do next?
That's not right!
You'll conduct a thorough evaluation to determine how well the laptop meets your evaluation criterion. You may rate your satisfaction based on each of the evaluative criteria you identified as important.
Continue


You recently purchased a new laptop for school after an extensive internal and external information search. What do you do next?
That's right!
Continue

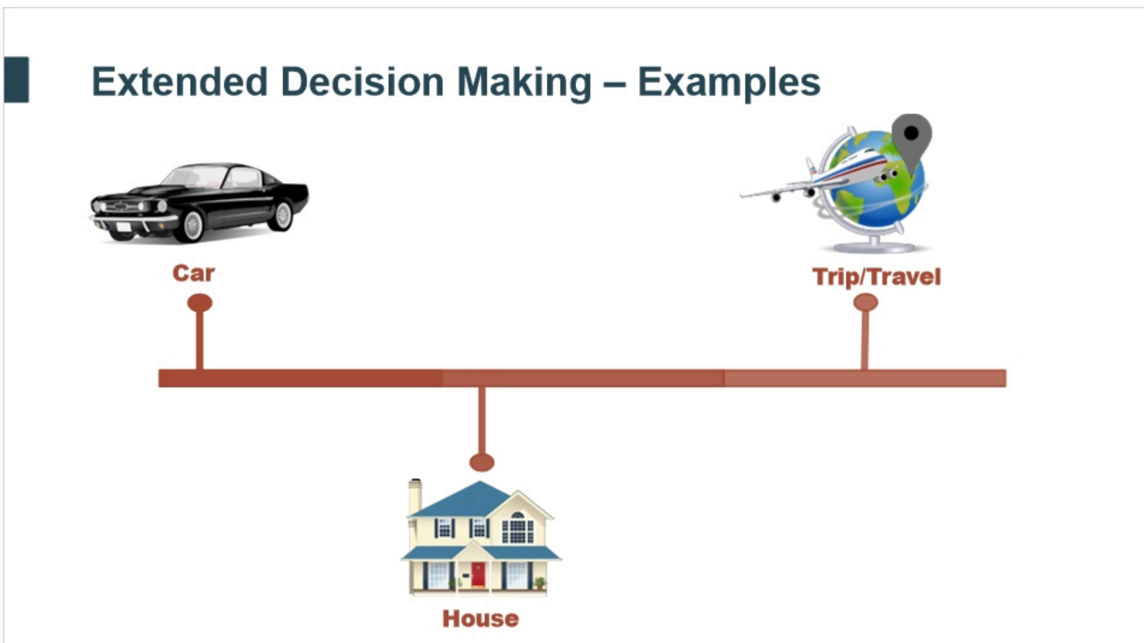
Lesson 3

Examples

Nominal Decision Making - Examples




Limited Decision Making – Examples
Cheese
Wine
Coffee


Extended Decision Making – Examples
Car
Trip/Travel
House

Summary

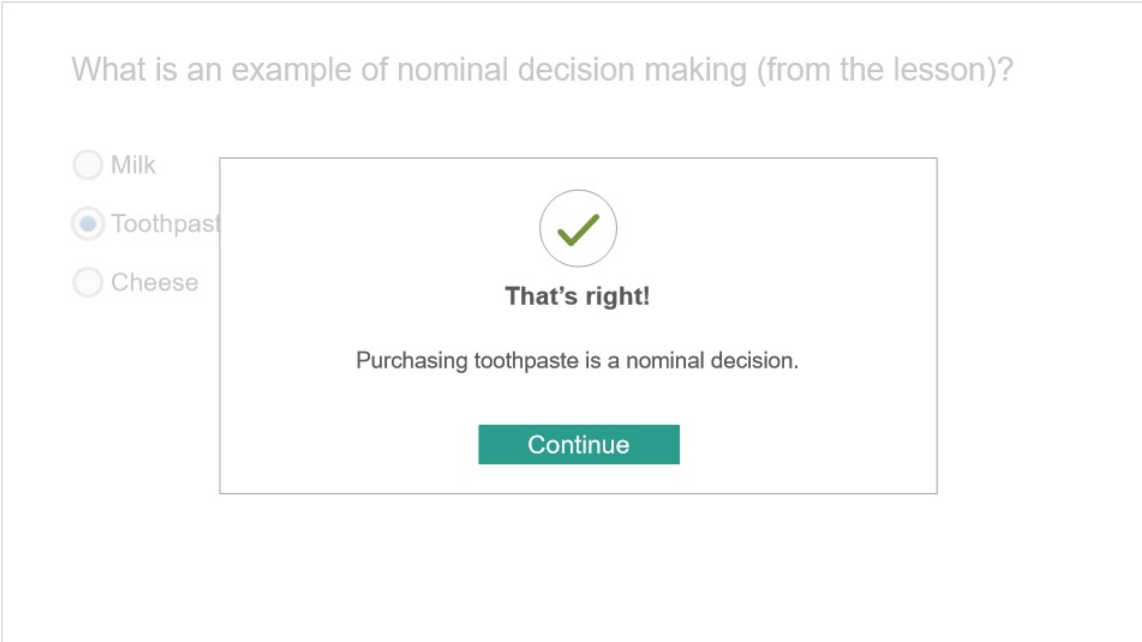
Type	Decision Making Process				
	Problem Recognition	Information Search	Alternative Evaluation	Purchase	Post Purchase
Nominal	Selective	Limited internal	None	Low involvement	• No dissonance • Very limited evaluation
Limited	Generic	• Internal • Limited external	• Few attributes • Simple decision rules • Few alternatives	Medium involvement	• No dissonance • Limited evaluation
Extended	Generic	• Internal • External	• Many attributes • Complex decisions rules • Many alternatives	High involvement	• Dissonance • Complex evaluation

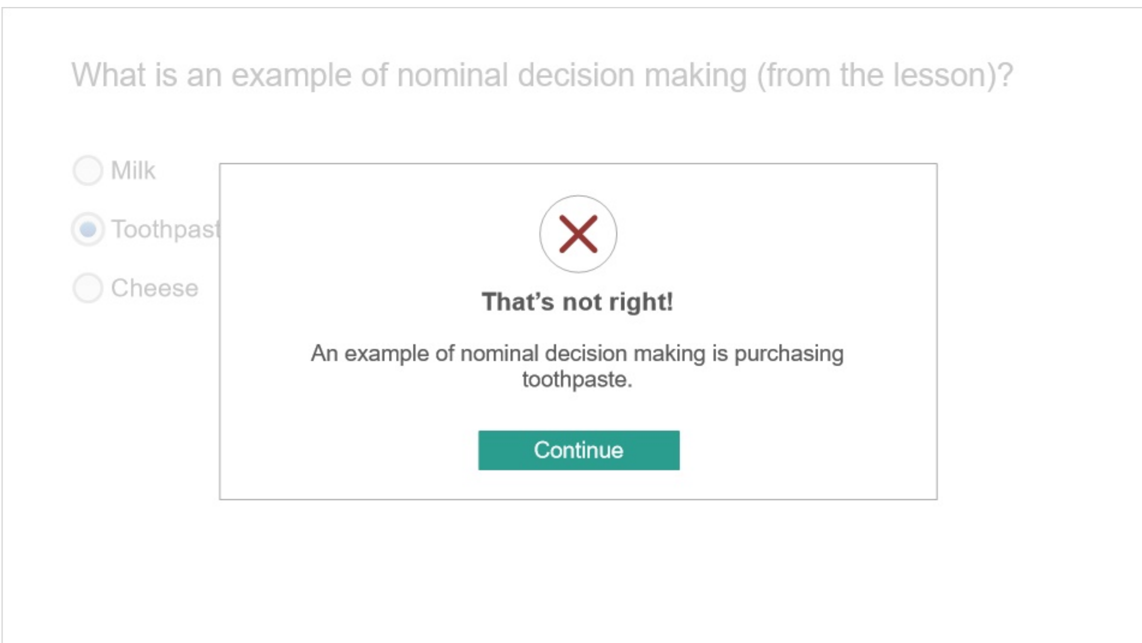
Review Question 5
(Multiple Choice, 1 attempt permitted)

What is an example of nominal decision making (from the lesson)?

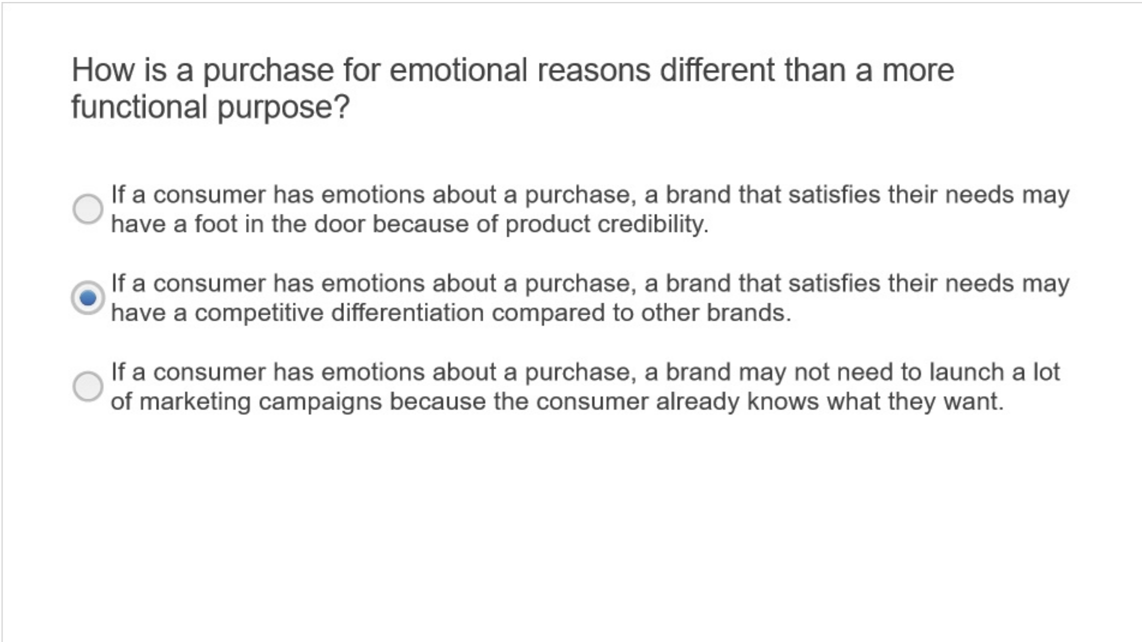
- ○ Milk
- ◉ Toothpaste
- ○ Cheese

Correct	Choice
	Milk
X	Toothpaste
	Cheese

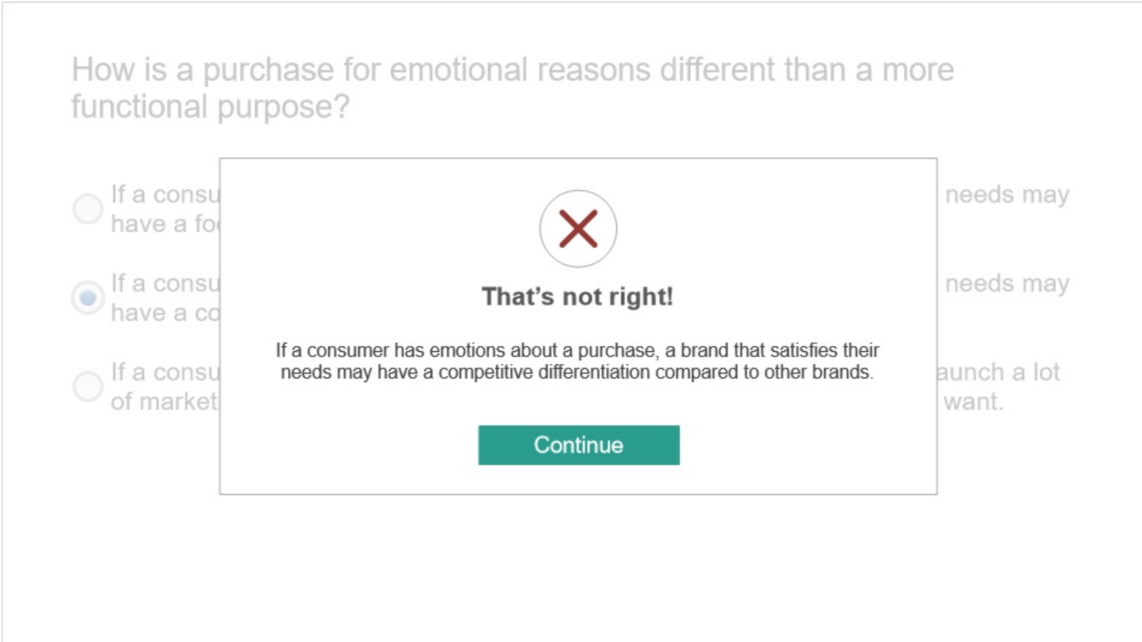

What is an example of nominal decision making (from the lesson)?
Milk
Toothpast
Cheese
That's right!
Purchasing toothpaste is a nominal decision.
Continue

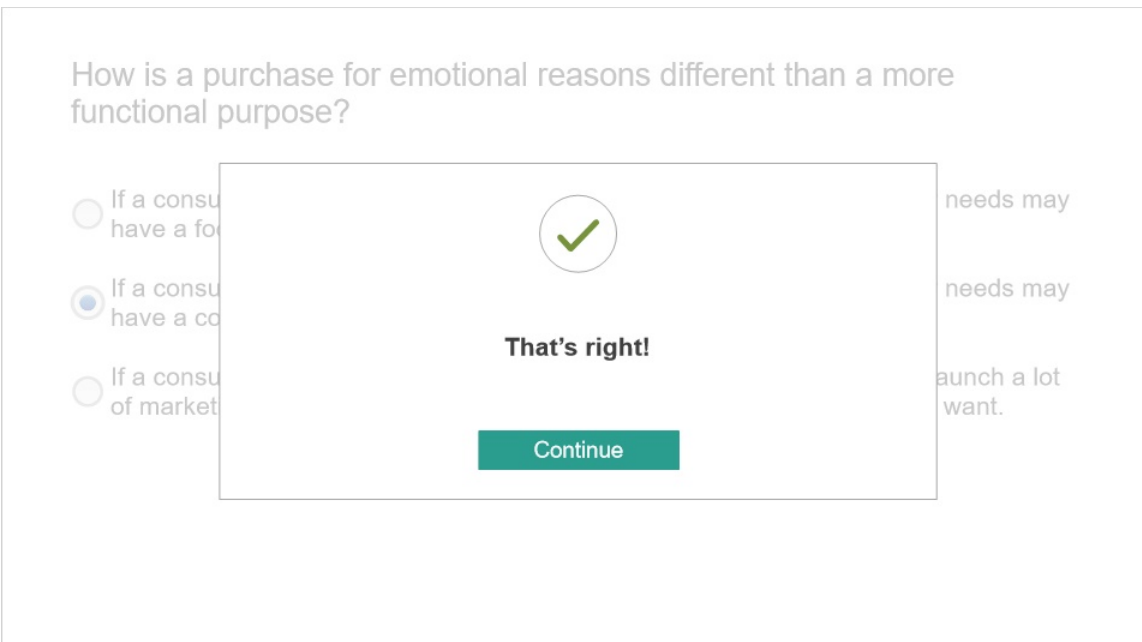

What is an example of nominal decision making (from the lesson)?
Milk
Toothpast
Cheese
That's not right!
An example of nominal decision making is purchasing toothpaste.
Continue

Review Question 6
(Multiple Choice, 1 attempt permitted)

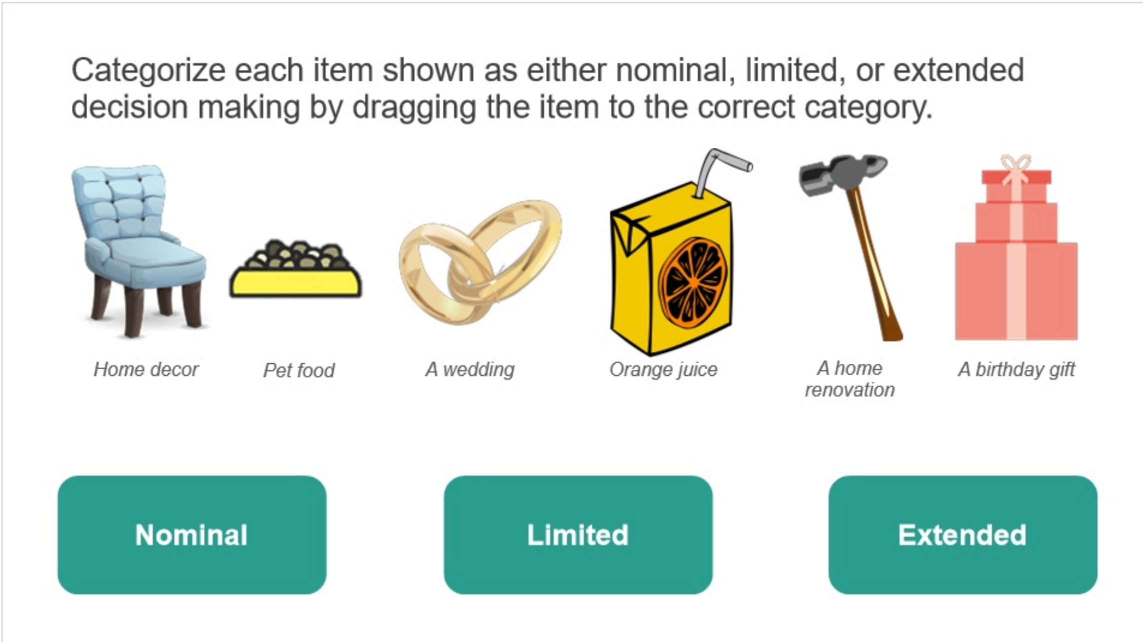


Correct	Choice
	If a consumer has emotions about a purchase, a brand that satisfies their needs may have a foot in the door because of product credibility.
X	If a consumer has emotions about a purchase, a brand that satisfies their needs may have a competitive differentiation compared to other brands.
	If a consumer has emotions about a purchase, a brand may not need to launch a lot of marketing campaigns because the consumer already knows what they want.


How is a purchase for emotional reasons different than a more functional purpose?
That's not right!
If a consumer has emotions about a purchase, a brand that satisfies their needs may have a competitive differentiation compared to other brands.
Continue

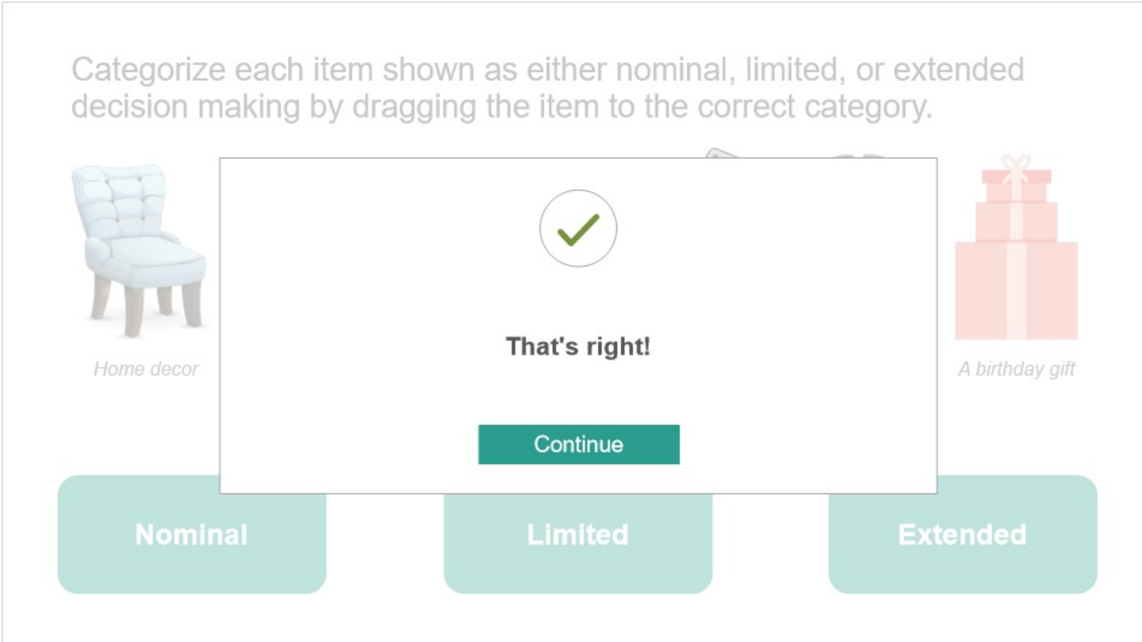

How is a purchase for emotional reasons different than a more functional purpose?
That's right!
Continue

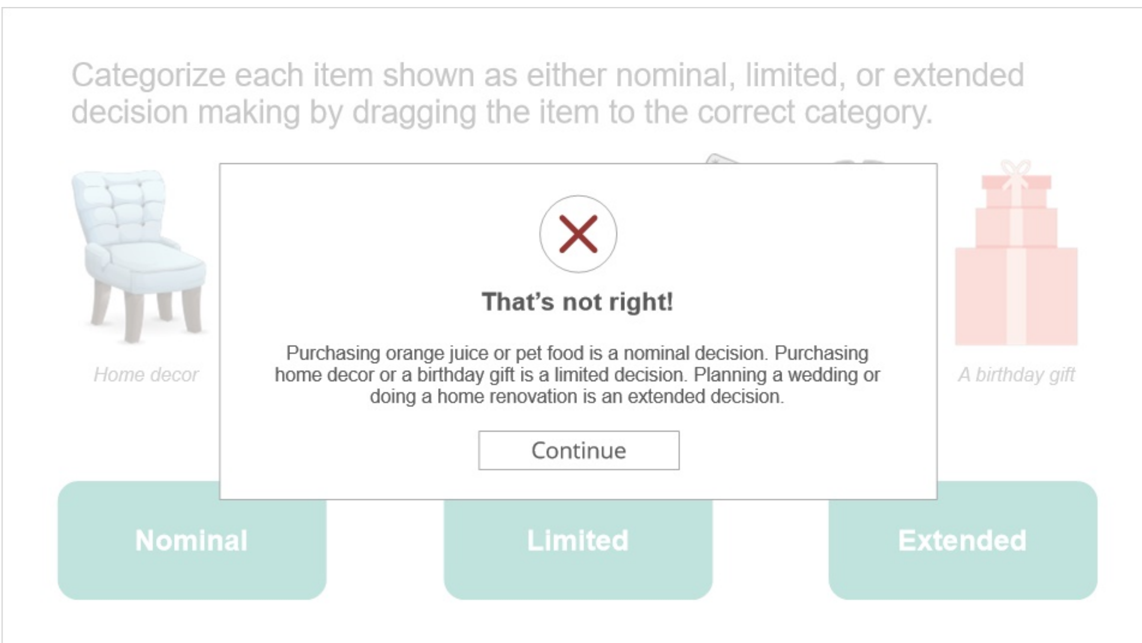
Review Question 7
(Drag and drop, 1 attempt permitted)



Drag Item	Drop Target
orange juice	Nominal
wedding	Extended
home decor	Limited
pet food	Nominal
home reno	Extended
bday gift	Limited

Drag and drop properties
Snap dropped items to drop target (Stack random)
Delay item drop states until interaction is submitted


Categorize each item shown as either nominal, limited, or extended decision making by dragging the item to the correct category.
Home decor
A birthday gift
That's right!
Continue
Nominal
Limited
Extended


Categorize each item shown as either nominal, limited, or extended decision making by dragging the item to the correct category.
Home decor
A birthday gift
That's not right!
Purchasing orange juice or pet food is a nominal decision. Purchasing home decor or a birthday gift is a limited decision. Planning a wedding or doing a home renovation is an extended decision.
Continue
Nominal
Limited
Extended

Module Complete!

Exit this module by clicking the button below.

Once you exit, go back to the course page on Moodle and **complete the posttest** under this week's course materials.

Exit Module

APPENDIX J

2x2 Analysis of Variance (ANOVA) with Planned Contrasts Tables

Test of Between-Subjects Effects

Source	Dependent Variable	df	F	η^2	p
Pretraining	RecallScore	1	.187	.001	.666
	TransferScore	1	.002	.000	.961
	OverallScore	1	.025	.000	.874
Segmenting	RecallScore	1	1.185	.009	.278
	TransferScore	1	.213	.002	.645
	OverallScore	1	.035	.000	.851
Pretraining* Segmenting	RecallScore	1	1.068	.008	.303
	TransferScore	1	3.984	.030	.048*
	OverallScore	1	4.383	.033	.038*

Test of Between-Subject Effects

Source	Dependent Variable	Noncent. Parameter	Observed Power[d]
Pretraining	RecallScore	.187	.071
	TransferScore	.002	.050
	OverallScore	.025	.053
Segmenting	RecallScore	1.185	.191
	TransferScore	.213	.074
	OverallScore	.035	.054
Pretraining * Segmenting	RecallScore	1.068	.176
	TransferScore	3.984	.509
	OverallScore	4.383	.547

Oneway Planned Contrasts ANOVA

		Sum of Squares	df	Mean Square	F	p
Recall Score	Between Groups	351.125	3	117.042	.751	.524
	Within Groups	20098.950	129	155.806		
	Total	20450.075	132			
TransferScore	Between Groups	403.140	3	134.380	1.455	.230
	Within Groups	11917.672	129	92.385		
	Total	12320.812	132			
OverallScore	Between Groups	321.847	3	107.282	1.474	.225
	Within Groups	9391.823	129	72.805		
	Total	9713.669	132			

Contrast Tests for Recall Score (Assumes Equal Variances)

Contrast	**Value of Contrast**	**Std. Error**	**T**	**p (1-tailed)**
1 (1 – 2)	1.32	2.864	.459	.324
2 (1 – 3)	-.12	3.049	-.040	.484
3 (1 – 4)	-3.33	3.142	-1.059	.146
4 (2 – 3)	1.44	3.049	.471	.319
5 (2 – 4)	4.64	3.142	1.478	.071
6 (3 – 4)	3.21	3.311	.969	.168
7 (1& 4, 2&3)	4.52	4.378	1.033	.152
8 (1 – 2&3)	1.19	5.069	.236	.407
9 (4 – 2&3)	7.85	5.690	1.380	.085

Note. An * indicates statistical significance at the $\alpha = 0.05$ level.

APPENDIX K

Handout

You are invited to participate in a research study that is completely separate from the FIN 1115: Personal Finance course requirements.

The Consumer Decision Making module in FIN 1115 has been designed for an experiment to test different ways to present materials from a learning perspective. The module is not required for a course grade but is useful information for business majors. This module will be used solely for research purposes and is completely **optional**. Your grade will not be impacted by the results of the study or your choice to participate or not participate.

This information is shown in the Moodle course for this week. You will complete the treatment (hosted in Moodle) then access the second link in the Moodle course for this week. This link will take you to an **anonymous** posttest hosted in Qualtrics. It is estimated that the treatment and posttest will take approximately 30 minutes to complete.

Do not put your name anywhere within to posttest to keep complete anonymity. You will not be asked for any identifying information. You will only be given questions about the content you viewed within the module and will be asked for consent to use your anonymous data at the end of the test. Choosing to deny the use of your data will not impact your grade.