

**Back to the Future:**  
**Effects of Olfaction induced Episodic Memories on Consumer Creativity and**  
**Innovation Adoption**

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## **ABSTRACT**

Back to the Future:

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Adoption

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Research suggests that in the presence of pleasant ambient scents people performed more creatively and efficiently, set higher goals, and employed effective strategies to accomplish those goals. However, it is yet unexplored - whether smells have an element of mental time travelling aside from their positive valence that may affect people's cognitive processes. This paper examined whether the olfactory cues, associated with childhood and playful activities, can activate creative thinking regardless of their valence. It was found that some smells can trigger strong feeling of mental time travelling due to their associations with childhood memories, subsequently affecting cognitive flexibility, a dimension of creativity, of individuals. This paper found significant main effect of such smells and significant mediation effect of creativity on the adoption intention for incongruent new products. These findings contribute toward various facets of consumer psychology and behavioural literature and entail substantial implications for sensory marketing.

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## Back to the Future:

### Effects of Olfaction induced Episodic Memories on Consumer Creativity and Innovation

#### Adoption

#### **1.0 Introduction**

Consumer creativity is currently one of the most intriguing topics in consumer research. There has been considerable amount of research conducted over last decade that explore various dimensions of consumer creativity (i.e. Burroughs and Mick, 2004; Hildebrand et al., 2013; Moreau and Dahl, 2005; Sellier and Dahl, 2011; Troye and Supphellen, 2012). Substantial amount of research works also explored the possibility of incorporating consumers' creative insight into the design and development of new products (Burroughs et al., 2011; Potts et al., 2008), while others explored the strategic implications of consumer creativity (Berthon et al., 2007; Kozinets, Hemetsberger, and Schau, 2008). However, generating solutions that are novel and creative alone does not seem to be enough to capture the attention of the consumers as well as to motivate them to adopt these solutions (Hoeffler, 2003; Alexander, Lynch, and Wang, 2008).

Research suggests that, new products have a high rate of failure ranging from 40% to 90% (Gourville, 2006). Hoeffler (2003) pointed out that although highly innovative products offer greater benefits to the consumers than existing products, consumers exhibit high level of uncertainty in understanding the utility of those benefits and anticipate any behavioural changes required to attain those benefits (Alexander, Lynch and Wang, 2008). From the consumers' perspective, the highly innovative products are perceived to be discontinuous with the existing normative values and beliefs (Hoeffler, 2003; Michael, Rochford, and Wotruba, 2003), hence they may not have immediate access to the cognitive resources, such as semantic schema, which

facilitates information processing, that eventually lead toward adoption of a complex, yet meaningful solution (Bagga, Noseworthy, and Dawar, 2016; Hoeffler, 2003).

Research found that activation of imaginative focus among individuals resulted into more favourable evaluation for “Really New” than “Incrementally New” products (Hoeffler, 2003; Zhao, Hoeffler, and Dahl, 2009). In similar vein, drawing upon the theory of schema congruity (Mandler, 1982) Jhang, Grant, and Campbell (2012) demonstrated that people developed more acceptance toward extremely incongruent products compared to moderately incongruent products, when they attained higher cognitive flexibility and thus could make more sense of incongruent new products. Therefore, one of prime ways to unleash a favourable mindset toward these “Really New” or “extremely incongruent” products is facilitation of imaginative focus or cognitive flexibility.

Playful experiences from childhood are argued to have a profound impact on imaginative and creative thinking, especially in generating creative solutions under challenging circumstances (Bateson and Martin, 2013). However, greater emphasis on goal-directed efforts and performances in a rule-bound, routine context obviates creative thinking among adults (Plucker, Beghetto, and Dow, 2004; Taylor and Getzels, 1975), and leads them toward undermining the significance of these playful activities (Root-Bernstein and Root-Bernstein, 2006). Hence, without intrinsic motivation it is difficult to engage adults in childlike playful activities, which can eventually facilitate their evaluation of highly innovative products.

Zabelina and Robinson (2010) found that activating childlike mindset in adults prompted more original thinking and creativity, since childhood is marked by playful mindset, spontaneity, and low self-consciousness (Csikszentmihalyi and Csikszentmihalyi, 1988; Langer, 1989). The self-relevant past experiences from childhood (i.e. crafting with Play-Doh, drawing with crayons,

etc.) and their activation is closely aligned to the concept of “episodic memories” (Tulving, 1985) and “mental time travelling” (Suddendorf and Corballis, 1997). These “episodic memories” in contrast to the “semantic memories” are more relevant to our “autonoetic consciousness” and entail reliving the events from the past (Tulving, 1985).

Literature suggests that olfactory cues have a much stronger link to our episodic memories and mental time travelling than do the verbal and visual cues (Herz, 2004; Herz and Schooler, 2002; Willander and Larsson, 2006), and these memories are significantly different than those triggered by verbal and visual information (Herz and Schooler, 2002; Willander and Larsson, 2006). The sense of smell is unique in that, it is directly connected to the emotion-center of the brain, and initiates immediate reaction preceding any conscious thought (Wilkie, 1995; Castellucci, 1985; Vlahos, 2007). Smell is also proclaimed to be the most accessible of all the senses as one simply cannot turn it off (Lindstorm, 2005). Unlike visual and auditory cues, a smell cannot be imagined or perceived before it is actually encountered in the context (Engen, 1982; Crowder and Schab, 1995; Köster et al., 1997). The human olfactory system can make distinction between up to 10,000 scents (Goldstein, 1999), and no matter how trivial the trace of the scent is, it can engender awareness and recognition, and trigger memories and mental associations related to the scent (Lee, 2000).

Therefore, this paper aims to examine the effects of olfactory cues on the evaluation of highly innovative products. Especially, it focuses to investigate whether a creative mindset could be activated among individuals through scents that are salient to childhood and playful experiences, which in turn would affect the adoption intention for highly innovative products more positively.

## **2.0 Literature Review**

In this conceptual section of this paper, the theories underlying the assumptions of this thesis will be discussed in details. This section aims to discuss the relevant research works in the domain of consumer creativity, episodic memories, olfaction, and innovation adoption behaviour, and identify the existing research gaps to be addressed in this thesis.

### ***2.1 Consumer Creativity***

#### ***2.1.1 Theories of Creativity***

The construct of creativity has been predominantly an area of interest for the psychological research. Creativity related research works did not surface until late 19<sup>th</sup> century, when a substantial amount of psychological research addressed this concept through theoretical construction and empirical investigation (i.e., Barron 1968; 1969; MacKinnon, 1961; Taylor, 1959). The well-accepted definition for creativity has been provided by J. P. Guilford (1950) in terms of the ability to engage in “productive thinking” that is – “the capacity to generate novel cognitive content” (Hirschman 1980). The solutions generated through the process of creative thinking must entail novelty, meaningfulness, and usefulness across different contexts. However, to what extent a solution will be creative depends both on the nature of problem encountered as well as the aptitude of the individual.

There have been various approaches over the time in conducting creativity research. The “mystical” approach considered creativity to be a spiritual force, pertaining to the “muse” aspect demonstrated by poets (Faullant et al., 2012). The “psycho-dynamic” approach pertains to the belief that creativity is an interaction between the unconscious self and conscious reality (Freud, 1908/1959). For a considerable amount of time, creativity has been seen as a “trait” only found

among the special few (Guilford, 1950). This school of thought views creativity to be rooted in the innate nature and features of an individual's personality.

On the other hand, the more contemporary view of creativity is based on the notion that an individual generates creative solutions when there is no one else interested in such "investment" (Sternberg and Lubart, 1991). It suggests that, unless there is a stimulating environment, individual creative attributes alone will not suffice for creative idea generation. The authors identified motivation as a key element to be creative and proposed that, many people are not creative only because they decide not to invest in it and do not converge the resources required to generate any creative solution.

### ***2.1.2 Importance of Playful Experiences***

Like any other aspect in our day to day life, consumption of products and services requires a lot of planning and thus, demand some level of creativity among the consumers. Consumer creativity can be defined as – "the problem solving capability possessed by the individual that may be applied toward solving consumption related problems" (Hirschman, 1980, p. 286). It has been argued that highly creative people are more likely to generate creative solutions to their consumption related needs, and are more prompt in solving any unexpected consumption problem through their choice of products and usage variations. Besides, consumers highly value the creative aspects of the goods they consume (Hirschman 1980). Moreover, they are also found to enjoy when engaged in creative activities (Dahl and Moreau, 2007). However, as many of our consumption decisions become routine, at one point of time, consumers tend to lose their creative flexibility (Hirschman 1980).

There has been a significant number of studies to shed light on different factors influencing creativity among consumers. For instance, Burroughs and Mick (2004) investigated the antecedents and consequences of creativity in a consumption context. The authors found that both contextual factors (such as, time constraints and contextual involvement) and individual differences (such as, locus of control, metaphoric thinking ability, etc.) influence creative consumption, and these factors also interact with each other. Moreau and Dahl (2005) studied the impact of input and time constraints on consumers' information processing during a creative task and demonstrated how those processes, in turn, influence the creativity of the solution. However, these research works are limited in addressing the way in which an individual's creative ingenuity can be unleashed (Hauser, Tellis, and Griffin, 2006).

Literatures in the domain of education and creativity have been investigating the issue of lost creative flexibility among adults (Plucker, Beghetto, and Dow, 2004; Taylor and Getzels, 1975). During the growing stages of childhood, humans' mental processes such as, working memory, inhibitory control, and flexibility (together called "executive function") work in collaboration with our creative side (Robertson, 2013). As humans grow into adults, their creative side diminishes as they spend more time in real, fact based reasoning and less time in carefree imagination (Runco, 2007). According to the theory of development by Kohlberg (1987), children start with *preconventional* stage where they have yet to develop a thinking process that complies with norms and use those norms in decision making. As children step into the *conventional* stage, they become more aware about these norms and social expectations, and thus replicate such normative behaviours with greater emphasis. This enhanced emphasis on conventional behaviours can work at such extremes that humans lose the meaning of engaging into activities that calls for

creativity and imagination (Root-Bernstein and Root-Bernstein, 2006), and thus become more rigid in their thinking style.

One way to break through this inflexibility is to invoke childlike mentality among adults. Zabelina and Robinson (2010) found that when asked to ‘think like a toddler’ adults produced more creative ideas than when they are asked to ‘think like themselves.’ However, without such explicit instruction (i.e. Zabelina and Robinson, 2010) or intrinsic motivation, adults cannot be engaged in nurturing their creative side through various forms of play (i.e. pretend play) (Finke, 1990; Amabile, 1983).

### ***2.1.3 The Role of Episodic Memories***

Runco and Chand (1995) proposed that, creativity is essentially the interactions among problem finding, ideation, and evaluation process, which are influenced by an individual’s knowledge structure and motivational elements. The knowledge structures can be either declarative (factual) or procedural (know-how), and motivational sources can be either intrinsic or extrinsic. Two important implications of this framework were highlighted in Runco and Chand’s (1995) work: (1) creative thinking requires complexity that enables “integration of complex, ambiguous, or novel information” (Charlton and Bakan, 1988-1989, p. 318), and (2) creative thinking must occur in a context that requires a dominant use of environmental cues to aid creative construction of problems (Mumford et al., 1993; Runco, Ebersole, and Mraz, 1991a; Runco, Okuda, and Thurston, 1991b).

In a similar vein, many literatures pointed out the significance of memory in creative thinking through conceptual models, such as Campbell’s (1960) “Blind variation and selective retention” and Simonton’s (1988) “Chance-configuration model.” Langley and Jones (1988)

proposed that, creativity can be facilitated through retrieval of the knowledge structures and concepts that are relevant to the context. Runco and Chand (1995) pointed out that, there are certain gaps in our semantic memories that at best provide a framework for the construction of our past experiences in a particular context, and episodic memories, on contrary, are able to fill in those gaps through creative process.

The distinction between semantic memories and episodic memories was first pointed out by Tulving (1972, 1983). According to Tulving, whereas semantic memories pertain to human's general understanding of the world, episodic memories pertain to human's individual experiences. He argued that episodic memories are more relevant to human's "autonoetic consciousness," which is not merely about knowing the factual information related to a particular event, but actually reliving it (Tulving, 1985). Later works of Squire (1992) and Myashita (2004) approved of this distinction and proposed that this distinction lies within human's declarative memory structure. Through experimental manipulations, neuro imaging studies, and observed dissociation of impairments among patients suffering brain injury, this distinction was further substantiated (Gardliner et al., 2002; Henson et al., 1999; Klein et al., 2002; Tulving, 2005).

Suddendorf and Corballis (1997) built upon this notion of episodic memories and coined the term "mental time travel" in order to describe the "faculty that allows humans to mentally project themselves backwards in time to re-live, or forwards to pre-live, events" (Suddendorf and Corballis, 2007, p. 299). According to Suddendorf and Corballis (2007), "Episodic memory is not about regularities, but about reconstructing particularities of specific events that have happened to the individual" (p. 301).

There is an increasing recognition that the notion of mental time travel into past and future provides humans with a significant evolutionary edge (Dudai and Carruthers, 2005; Suddendorf

and Busby, 2003; Suddendorf and Corballis, 1997; Tulving, 2005). It has been argued that, having access to the future in terms of mental time travel is crucial since the ability to foresee the future and successfully plan for it increases the chance of survival (Dawkins, 2000; Suddendorf and Corballis, 2007). Moreover, it has been argued that mental time travel involves “fine-tuning mechanisms” for future adaptations that are facilitated through flexible memory structure of episodic memories (Suddendorf and Corballis, 2007, p. 300).

This concept of revisiting one’s past and pre-living one’s future is significant in relation to creativity, because both mental time travelling and creativity require individuals to engage in a generative processing that involves planning for an event that is anticipated to occur in future (Finke, Ward and Smith, 1992; Suddendorf and Corballis, 2007). Maddux and Galinsky (2009) found that priming individuals to recall their experiences of living abroad made them more creative momentarily. The reason behind is argued to be the “behavioural and cognitive scripts” (i.e. Bargh, 1989; Langer, Blank, and Chanowitz, 1978; Srull and Wyer, 1979) that were encoded during the initial learning experiences in multicultural context, and were subsequently reactivated in a salient context leading toward the generation of creative outputs through original thinking (Maddux, Adam, and Galinsky, 2010, p. 733). Recalling these multicultural experiences is similar to recalling childhood memories or pretending to be a child (i.e. Zabelina and Robinson, 2010), since it entails destabilization of conventional thinking, and increasing one’s ability to think unconventionally (Leung et al., 2008).

## ***2.2 Olfactory Cues and Human Cognition***

### ***2.2.1 Human Olfactory System and Associative Learning***

Before practitioners and academicians shifted their attention to the effects of olfactory cues on consumer behaviour, several studies on human olfactory system have been conducted in the domain of cognitive neuroscience. Since Jim Olds' discovery in 1953 that, the Rhinencephalon region of brain (also known as 'Smell Brain') in rats were linked to their behavioural patterns, researchers have thrived to find the similar linkages among olfaction, emotion, and behaviour in humans (Shiu, Walker and Cheng, 2006).

Among all senses of humans, smell is most proximal to the emotion center of the brain (Wilkie 1995). Olfactory afferent mechanisms have a unique, direct connection to the amygdala and hippocampal complex, the neural substrates for emotional processing (Turner, Mishkin, and Knapp, 1980; Cahill et al., 1995). Olfactory nerve is only two synapses away from the amygdala, which is central to experiencing and processing emotions (Aggleton and Young, 2000) and maintaining emotional memory (Cahill et al., 1995). On the other hand, it is only three synapses away from the hippocampus, which is actively involved in information selection and transmission in working memory, in transmissions between short-term and long-term memory, and in various operations within declarative memory structure (Eichenbaum, 1996; Schwerdtfeger, Buhl, and Garmoth, 1990; Staubli, Ivy, and Lynch, 1984).

Most importantly, olfactory cues have been found to activate the orbitofrontal cortex and amygdala, which play major roles in stimulus-reinforced associative learning (Phillips and Heining, 2002; Rolls, 1999; Zatorre et al., 1992). Lorig and Schwartz (1988) and Ehrlichman et al. (1997) found that olfactory cues can trigger involuntary behavioural responses among humans. Epple and Herz (1999) investigated this associative learning aspect of odors with five-year olds by

asking them to solve an impossible maze (the “failure maze”) in a scented room. Since the maze was unsolvable, subjects reported to have high levels of frustration. After a 20 minute break in an unscented area, subjects were again randomly assigned to a room scented with either the similar odor from the “failure maze” task, a novel odor, or no odor. Subjects were asked to complete a cognitively challenging task, and it was found that subjects, who were situated in the same odor presented during the “failure maze” task, performed significantly worse than those situated in novel or no odor condition. The performance of the subjects in novel odor and no odor condition did not differ significantly from each other. Thus, it was evident that humans can become experientially conditioned to odors and subsequent exposure to those odors can trigger similar behavioural patterns. However, this study (Epple and Herz, 2002) tested the theory of associative learning for a short span of time and subjects were exposed to the odor only once. Thus, it leaves the scope for investigating the cognitive effects of repetitive exposure to a scent for a longer period of time (i.e. childhood).

### ***2.2.2 Olfactory Cues and Episodic Memories***

Research suggests that, olfactory cues can trigger memories that are significantly different than those triggered by verbal and visual cues (Herz and Schooler, 2002; Willander and Larsson, 2006). As Willander and Larsson (2007) pointed out in their work, “...verbal cuing of memories generates a reminiscence bump between the ages of 10-30 years at event. However, in contrast with a memory peak in young adulthood, olfactory cued memories have been localized to the first decade of life indicating that odor representations are older than verbal and visual ones” (p. 1659). It has been strongly evinced by the phenomenological researchers that olfactory cues have a much stronger link to our episodic memories and mental time travelling than do the verbal and visual

cues (Herz 2004; Herz and Schooler, 2002; Willander and Larsson, 2006). The semantic knowledge of the olfactory cues, such as perceived familiarity and perceptibility, were found to be positively associated with the retention of episodic olfactory information (Larsson, 1997; Larsson and Backman, 1997).

Moreover, the olfaction induced memories were found to be more emotional in nature compared to the memories evoked by other sensory cues (e.g., Herz, 1998; Herz and Cupchik, 1995; Herz et al., 2004). In similar notion, Vlahos (2007) and Wilkie (1995) asserted that smell represents a direct link to the feelings happiness and hunger, and consists of a “sensory bandwidth” that cannot be avoided (Bradford and Desrochers, 2009, p. 142). The reason behind is assumed to be the structure of human nervous system, in which olfactory bulbs are directly connected to the emotion processing region – the amygdala, and the memory formation and associative learning region – the hippocampus (Herz, 2002). Technically, the olfactory bulb, the amygdala and the hippocampus are only distanced by a few synapses among themselves, and thus, the connections among smell, memory and emotion are both physical and conceptual (Krishna, 2013).

### ***2.2.3 Effects of Olfactory Cues on Judgment and Cognitive Performance***

The aforementioned studies created the platform for further research on the effects of olfactory cues in more complex behavioural contexts such as, consumers’ evaluation, preference, and purchase intention for various products. Hirsch and Gay (1991) found that consumers were more likely to purchase a product (i.e. Nike athletic shoe) in an odorized compared to a non-odorized one. Extending this study to a gambling context in Las Vegas, Hirsch (1995) found that among three experimental conditions (two scented vs. one non-scented), people spent significantly more money (45%) in one of the scented conditions over the other two conditions.

In another study Spangenberg, Crowley, and Henderson (1996) found that scented retail environment increased consumer's evaluation of the product and shopping experience. Interestingly, scented environment compared to unscented environment also reduced consumer's perception of time spent in the store. However, the products, which were already evaluated positively, did not show improvement in their evaluation in a scented environment. In more recent studies, it has been found that ambient scent is significantly associated with enhanced recall and recognition of previously encountered brands (Morrin and Ratneshwar, 2003). Bosmans (2006) also found that, ambient scent can result in improved product evaluation as it has affect-based semantic connections with memories, such as roses and babies. In a more intriguing study conducted in 2005, a significant effect of ambient scents was found on reflective and impulsive buying behaviours. In a scented environment, reflective buyers (planned decision making) were found to spend more money, whereas the impulsive buyers (unplanned decision making) were found to spend less (Ravn, 2007).

Mitchell, Kahn, and Knasko (1995) examined the congruity of scent and its effect on information processing system. The study found that, congruent scent triggered a complex decision making process among the respondents, where they took more time in processing information and considered all product attributes equally. Moreover, respondents also engaged in variety seeking behaviour when scent was congruent with the product class. From these findings, Mitchell et al. (1995) concluded that consumers encounter 'cognitive enrichment' as olfactory cues activate memories associated with a particular stimulus, which consequently facilitates the decision making process.

Research has found support that pleasant ambient scents make people more creative in problem solving compared to the unpleasant scents (Herz, 2002). Toth (1989) demonstrated the

case of a Japanese firm which reduced the error rate of keypunch operators by 50% and 80%, respectively, through introduction of lemon and lavender fragrances in the environment. Literature also supports strong impact of the presence of olfactory cues in the environment on prosocial behaviours and productivity (Baron, 1997; Herz, 2002). People working in a scented environment reported higher efficiency, setting higher goals and employed effective strategies to accomplish those goals, compared to those working in a non-scented environment (e.g., Kliauga, 1996; Barker et al., 2003). The aforementioned studies consider valence of a particular scent accountable for the effects, however, the number of research that investigates whether memories associated with ambient scents can facilitate cognitive functioning (i.e. creative thinking) in a particular context has been very limited.

## ***2.3 Innovation Adoption Behaviour***

### ***2.3.1 The Schema Congruity Effect***

Lower acceptance rate for new products have prompted intensive research in the arena of innovation adoption behaviour. It is argued that the extent of a new product's deviation from the category expectations increases the likelihood of the product to fail, especially due to consumers' difficulty in understanding the benefits of product (Hoeffler, 2003; Moreau, Markman, and Lehmann, 2001). Among all the theories that have been put forth toward the understanding of category fit of new products, the theory of schema congruity proposed by George Mandler (1982) remains the most influential one and garnered strong support through extensive research works in subsequent era (i.e. Aggarwal and McGill, 2007; Campbell and Goldstein, 2001; Jhang, Grant, and Campbell, 2012; Meyers-levy and Tybout, 1989; Noseworthy, Cotte, and Lee, 2011; Noseworthy, Di Muro, and Murray, 2014; Noseworthy and Trudel, 2011; Noseworthy, Finlay, and Islam, 2010;

Peracchio and Tybout, 1996; Sheinin and Schmitt, 1994; Stayman, Alden, and Smith, 1992; Sujan and Bettman, 1989). Literature supports that, the level of incongruity between an object and its associated schema can influence how a person evaluates that particular object (Cohen and Basu, 1987; Fiske, 1982; Meyers-Levy and Tybout, 1989; Srull, 1981; Sujan, 1985). Mandler (1982) argued that this happens because people like objects that conform to their expectations, *ceteris paribus*. However, affective response toward congruent objects tend to be mildly positive, since these objects are not engaging in particular, whereas, incongruent objects stimulate arousal and are more engaging in nature (Mandler, 1982).

The theory posits that the relationship between the level of incongruity of an object and its evaluation follows an inverted-U function, such that, moderately incongruent objects will elicit more positive response, since people can reach incongruity resolution without changing their existing knowledge structure dramatically, whereas extremely incongruent objects will elicit more negative response, since people may require to develop an entirely new schema or change their existing knowledge structure dramatically (Meyers-Levy and Tybout, 1989). Therefore, accommodating extremely incongruent product into existing schema will be more taxing than that of moderately incongruent product (Sujan and Bettman, 1989). This dynamic relationship between schema incongruity and affective response has been used in marketing and consumer research extensively to explain the preference for moderately incongruent products over extremely incongruent products (Campbell and Goldstein, 2001; Jhang et al., 2012, Maoz and Tybout, 2002; Meyers-levy and Tybout, 1989; Noseworthy et al., 2011; Noseworthy et al., 2014; Peracchio and Tybout, 1996; Sheinin and Schmitt, 1994; Stayman, Alden, and Smith, 1992). People are found to generate detailed inferences about a product's category fit by their physical appearances (Noseworthy and Goode, 2011; Noseworthy and Trudel, 2011). Later work by Di Muro and

Noseworthy (2013) suggests that, this inference based evaluation may also hold true for the means of purchase and consumption - money itself.

Mandler (1982) predicted the relationship between schema incongruity and affect intensity to be the outcome of physiological arousal. He argued that when people can reach a resolution for moderate incongruity, they develop a positive emotional state; but when they cannot reach a resolution for extreme incongruity they develop a negative emotional state (Mandler, 1982). This speculation is consistent with the findings that incongruity resolution leads toward greater task satisfaction (Maoz and Tybout, 2002) and it mediates the affective response toward incongruent objects (Jhang et al., 2012). Therefore, these findings highlight the necessity to facilitate the cognitive processes that can help people reach incongruity resolution, and in turn, evaluate the “extremely incongruent” products more favourably.

There have been numerous research to provide comprehensive framework on the positioning of a new product. For instance, Keller, Sternthal, and Tybout (2002) posited that both frame of reference (“what is it?”) and points of difference (“what of it?”) can act as the sources of incongruity. Another source of incongruity is based on the “psychological newness” of the products, which posits that “really new” products cannot be classified into existing categories (i.e. Gregan-Paxton et al., 2002). However, facilitation of mental simulation (i.e. imaginative focus) (Zhao, Hoeffler, and Dahl, 2009) and cognitive flexibility (Jhang et al., 2012) led toward more favourable evaluation of “extremely incongruent” and “really new” products, respectively. Now, this paper intends to explore an alternative way (i.e. Mental Time Travel) to facilitate such cognitive flexibility among individuals that may lead them toward developing favourable responses toward the “extremely incongruent” products.

### ***2.3.2 Framework for Categorizing Technological Innovations***

In this paper, special interest was taken in examining the adoption intention for technological innovations. Tushman and Anderson (1986) argued that technological changes cannot be accommodated within a firm, when an innovation destroys rather than enhance a firm's current expertise. Since technological innovations can create entirely new market, with new products, new consumers, and rapidly increasing demands, firms can incur a substantial cost by misinterpreting such impacts (Sood and Tellis, 2011). Therefore, it is important to understand how these innovations can be categorized as “moderately incongruent” or “extremely incongruent” products based on their composition and design, so that a suitable approach can be taken to facilitate their adoption. With this regard, several framework for categorizing technological innovations have been explored.

Christensen's (1997) theory on disruptive innovations has been one of the most popular one among all existing frameworks. The theory posits that disruptive innovations hardly find any value in the established market, since these innovations tend to be much simpler than the existing products, and therefore, fail to deliver on the features (primary dimension) that are desirable to the mainstream segments. However, through a different attribute packaging these innovations provide value to the niche segments – emerging and low-end markets (Christensen, 1997; Govindarajan and Kopalle, 2006).

Sood and Tellis (2011) provided with a comprehensive schema to define various technological innovations. They addressed major weaknesses in earlier propositions of “disruptive” technological changes (i.e., Tushman and Anderson, 1986; Christensen, 1997) and defined key technological concepts in terms of product characteristics rather than tautological end effects. According to their proposed construct, this paper accepts the definition of technology as

“a platform based on a unique scientific principle, on which firms manufacture products to serve customer needs in a particular market” (Sood and Tellis, 2011, p. 340). They also argued that there are three types of technological changes – platform, component, and design.

Although, these classifications and the comprehensive framework have proven to be highly significant for the firms’ strategic management, one ongoing concern is - consumers may not be able to distinguish among different technologies (Sood and Tellis, 2005). This is because, even when a technology radically differs from another technology, firms use similar interfaces for both products to trigger consumer adoption. Extant literatures in product adoption behaviour also suggest that it is in marketers’ best interest to make the product seem less revolutionary to reduce the uncertainty and perceived performance risk (Alexander, Lynch, and Wang, 2008). This view is consistent with that of Hoeffler, Moreau, and Kubowicz-Malhotra (2006), who demonstrated that positioning “Really New” products on their less new attributes led to more acceptance.

Since this paper aims to understand consumer’s perception and cognition, it is important to define these technological changes (Sood and Tellis, 2011) in a way that corresponds to the schema incongruity effect. “Extremely Incongruent” product is defined as a prototype that entails a change in core attribute and thus share no association with the existing category schema. “Moderately Incongruent” product is defined as a prototype that entails a change in peripheral attribute and thus share some association with existing schema for its category (Table 1).

Table 1: Typology of New Products

<i>Proposed Schema</i>			<i>Sood and Tellis (2011, 2005) Schema</i>			<i>Christensen (1997) Schema</i>		
<b>Proposed Term</b>	<b>Proposed Basis</b>	<b>Proposed Argument</b>	<b>Sood and Tellis (2011, 2005) Term</b>	<b>Sood and Tellis (2011, 2005) Basis</b>	<b>Sood and Tellis (2011, 2005) Argument</b>	<b>Christensen (1997)'s Term</b>	<b>Christensen (1997)'s Basis</b>	<b>Christensen (1997)'s Argument</b>
“Extremely Incongruent Product”	1. Incorporates a change in core attribute or primary dimensions.	Extremely Incongruent products will lead toward less favourable adoption intention (later time of adoption) compared to Moderately Incongruent Product, since they defy the expectations from existing category (change in core attribute).	Platform Innovation	Unique Scientific Principle	<p>1. Market has two technologies (Dominant and New), two dimensions (primary and secondary) and two segments (mainstream and niche) (Christensen, 1997).</p> <p>2. Segments have fixed preference, but technology improves over time (Christensen, 1997).</p> <p>3. There are two types of technological attacks – upper attack and lower attack.</p> <p>4. Niche segment provides demand for platform innovation, while it improves on primary dimension to appeal mainstream segment.</p>	Sustaining Breakthrough	A platform innovation - superior on primary dimension, but inferior on secondary dimension.	Highly favoured by mainstream consumer segment; features are desirable in established markets.
	2. Contradicts the existing category schema.					Disruptive	A platform innovation – superior on secondary dimension, but inferior on primary dimension.	Highly favoured by the niche segment; features (secondary dimension) are desirable in emerging markets, but not in established market.

“Moderately Incongruent Products”	1. Incorporates change in peripheral attributes or secondary dimensions.  2. Have some shared connections with existing category schema.	Moderately Incongruent products will lead toward more favourable adoption intention (earlier time of adoption) compared to Extremely Incongruent Product, since they meets some expectations from existing category (change in peripheral attribute).	Design Innovation	Linkages or layout within same scientific principle	1. Refinement of products’ design and component without changing the core scientific principal.  2. Improves the products’ performance along the primary dimension.	Sustaining Incremental	A component innovation with minor improvement on primary dimension.  A component innovation – superior in secondary dimension, but inferior in primary dimension.	Highly favoured by mainstream consumer segment; features (primary dimension) are desirable in established markets.  Highly favoured by mainstream consumer segment; features (secondary dimension) are desirable in emerging markets, but not in established markets.
			Component Innovation	Materials or parts within same scientific principle		Disruptive		

### ***2.3.3 Relationship between Evaluation and Adoption Intention for New Products***

What actually motivates consumers to adopt an innovative product has remained quite a puzzle for the marketers. In most market surveys, marketers use the intention to purchase a product as a substitute to measure the anticipated buying behaviour. However, such proxy measure can be quite misleading and poorly indicate the success rate of an innovative product. Sheppard, Hartwick, and Warshaw (1988) found that, the correlation between intention and behaviour is 0.53. Making the scenario even more challenging, Morwitz, Steckel, and Gupta (2007) found that, this correlation is significantly lower for the new products versus the existing ones. Synovate (2007) reviewed the intention and adoption behaviour for different categories of innovation (e.g., FMCG, cars, PCs, home furnishing, etc.) and found that purchase intention cannot capture 91% variance in the purchase behaviour.

The unexplained variance has been attributed to the change of intention over time (Morrison, 1979), inability of the consumers to anticipate the impactful events prior their adoption decision as well as the use of biased estimates by researchers in measuring innovation adoption (Ittersum and Feinberg, 2010). Moreover, evaluation of innovative products is argued to be a continuous goal-directed process, which entails certain purposes and situations pertaining to the utility of the product attribute that affects the overall evaluation of the innovation (Gardial et al., 1994; Vandescateele and Geuens, 2010). Therefore, consumers tend to evaluate the innovative products differently under different circumstances and purposes in their mind, which results in an inconsistent relationship between the intention and adoption behaviour (Gollwitzer, 1999).

A comprehensive meta-analysis by Arts, Frambach and Bijmolt (2011) revealed that consumers demonstrate high intention of adoption when the innovation is more complex, suited to their needs and implies lower uncertainty. Here, complexity is often considered as a signal of high

quality (Taylor and Todd, 1995). However, this complexity which is a prime indicator of novelty and advancement in intention stage, becomes a barrier to actual adoption in behaviour stage (Berlyne, 1971; Messinger, 1998). In previous sections, it has been highlighted that resolution of incongruity of new products through facilitation of cognitive flexibility led toward favourable evaluation of “extremely incongruent” products versus “moderately incongruent” products (Jhang et al., 2012). In this paper, it is examined whether consumers can overcome the incongruity and subsequently form stronger adoption intention, measured by the time of adoption, for these two levels of incongruent products.

#### **2.4 Summary of Research Gaps**

As discussed in the previous section, few research works address the effects of olfactory cues on cognitive processing and role of consumer creativity while evaluating products and services in an immediate context. Previously discussed studies (i.e. Herz, 2002; Toth, 1989; Kilauga, 1996; Barker et al., 2003), which are predominantly, conducted within an organizational setting, poses the question – whether olfactory cues affect the cognitive performances similarly in a consumption context.

Creativity researchers emphasize the importance of getting engaged into playful experiences to nurture innate creativity (Root-Bernstein and Root-Bernstein, 2006). The contemporary view of creativity posits that creativity is not a privilege of chosen few (Trait Approach; Guilford, 1950), and it requires individual’s intention to invest in it, as well as, a stimulating environment (Sternberg and Lubart, 1991). However, there are very few research works that investigate the effects of environmental cues on stimulating creativity, without requiring people to actively get involved in playful activities in an immediate context.

Additionally, current body of research on sensory modalities does not investigate the association between olfactory cues and episodic memories that can drive the effects observed cognitive performances. Research conducted by Maddux and Galinsky (2009) showed that priming individuals to recall their experience of living abroad made them more creative momentarily. Currently, however, there is no evidence on how people's cognitive processes will be affected when they are primed with smells relevant to particular events and memories.

Innovation adoption literature discusses the importance of cognitive facilitation (i.e. cognitive flexibility) and imaginative focus for generating favourable response toward highly innovative products (Hoeffler, 2003; Jhang et al., 2012; Zhao et al., 2009). Given the rising concern over the high failure rate of highly innovative products, it is crucial to investigate the ways of such cognitive facilitation with greater emphasis. However, there is few research works that address how such activation can occur without any explicit intervention in a consumption context.

These research gaps identified in the literatures of consumer creativity, olfaction, and innovation adoption behaviour outline the scope for my thesis. The conceptual framework of my thesis has been discussed in detail in the next section.

## **2.5 Conceptual Framework**

In order to address the research gaps discussed earlier, in this section I have systematically organized the constructs of interest and linked them together in a cohesive manner.

First of all, I am interested to investigate how different smells affect people's cognitive performances as evident from previous literatures (i.e. Herz, 2002). Previous research has attributed the effects of ambient scent on cognitive performance to the valence of the smell, as well as, positive mood induced by this smell. The objective of my investigation is to rule out this

positive valence as an alternate explanation to the observed effects in people's creative performance. The proposed model in this paper seeks to substantiate the fact that certain smells become strongly associated with particular events in our life and gets embedded into our cognitive scripts. Thus, when exposed to those smells, it brings back our memories from event and puts us in the mindset congruent to that event. This strength of association between the smell and the memory should play a pivotal role in mental time travelling, regardless of the valence associated with the smell.

Second, this paper aims to address the question – how cognitive flexibility can be activated among people in a consumption context without providing them any explicit instruction. Since, cognitive flexibility has been found to be conducive in the evaluation of highly innovative products, this thesis seeks to investigate the phenomenon in the context of innovation adoption behaviours. A large proportion of new products fail in the market, not only because of poor strategic decisions, but also for the lack of cognitive resources from consumers' end. Therefore, it is one of my principle interests to figure out a way to trigger creative thinking among consumers without explicit intervention and lead them toward forming stronger adoption intention for highly innovative products.

Third, if valence of the smell can be ruled out as an alternative explanation for creative performance, this paper also aims to examine whether exposure to certain smells that have strong association to childhood memories and playful experiences can generate positive evaluation for highly innovative products. I argue that when exposed to such smells, creative thinking will be facilitated among individuals, which, in turn, will lead people toward forming earlier adoption intention for these products.

Finally, I also aim to investigate whether facilitation of creative thinking through smell will have similar effects across the levels of innovation. Previous literature has found support that facilitation of cognitive flexibility and imaginative focus will lead to more favourable evaluation for “extremely incongruent” and “really new” products (Jhang et al., 2012; Hoeffler, 2003; Zhao et al., 2009). It would be of particular interest to test for such effect, when people are primed with smells in a consumption context.

### 3.0 Research Hypotheses:

The conceptual framework described above will be substantiated through the following hypotheses. Each hypothesis is described in details in the following section.

#### 3.1 Main Effect of Smell on Mental Time Travelling

**H1a:** There will be a main effect of the smell on the feeling of mental time travelling such that, when the smell is relevant to childhood and playful activities, it will induce a stronger feeling of mental time travelling among individuals compared to when it is not relevant to childhood and playful activities.



Figure 1: Conceptual Model - H1a

#### 3.2 Conditional Effect of Smell' Valence on Mental Time Travelling

**H1b:** The main effect smell on the feeling of mental time travelling will be moderated by the valence of the smell, such that when the valence of the smell is positive, it will induce a stronger feeling of mental time travelling than when the valence of the smell is negative.

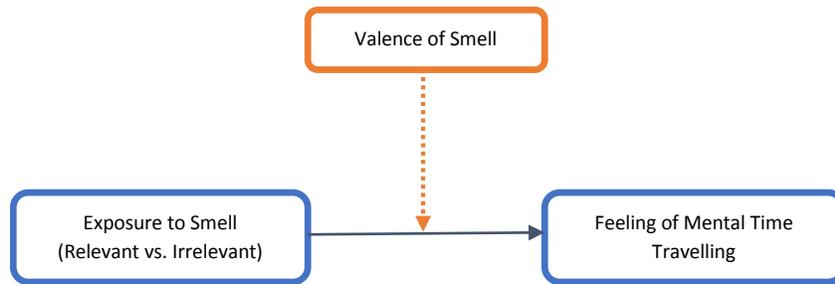


Figure 2: Conceptual Model - H1b

### 3.3 Main Effect of Smell on Time of Adoption

**H2a:** There will be a main effect of smell on people’s adoption intention for innovative products, such that when people are exposed to a smell that is strongly associated with their childhood memories will demonstrate earlier adoption intention (time of adoption) for innovative products than when they are exposed to a smell that is not strongly associated with their childhood memories.



Figure 3: Conceptual Model – H2a

### 3.4 Mediation Effect of Creativity on Time of Adoption

**H3b:** The effect of the exposure to smell that is relevant to childhood on adoption intention (Time of Adoption) will be mediated through the activation of creative thinking, such that when exposed the smell facilitating the recall of childhood memories will activate creative thinking among individuals, and will eventually lead them toward forming earlier adoption intention. In contrast, when the individuals are exposed to a smell that is not relevant to their childhood, creative thinking will not be facilitated, and thus will not lead toward the formation of earlier adoption intention.

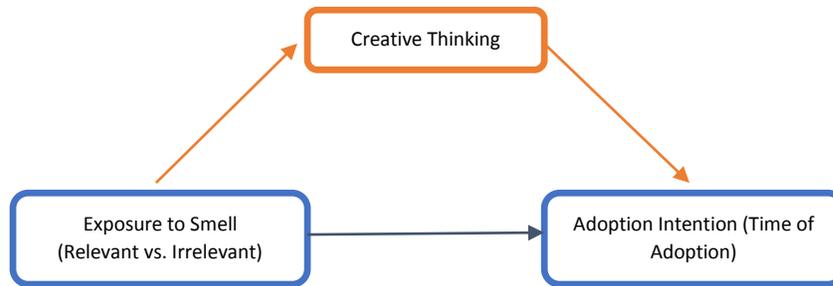


Figure 4 Conceptual Model – H2b

### 3.5 Moderated Mediation Effect of Type of Innovation

**H3c:** The indirect effect of the smell that is relevant to childhood experiences on adoption intention (Time of Adoption) through creativity will be moderated by the type of innovation, such that when creativity is facilitated under relevant smell condition, people will develop earlier adoption intention for “extremely incongruent” products than for “moderately incongruent” products. In contrast, when creativity is not facilitated under irrelevant smell condition, people will develop earlier adoption intention for “moderately incongruent” than for “extremely incongruent”.

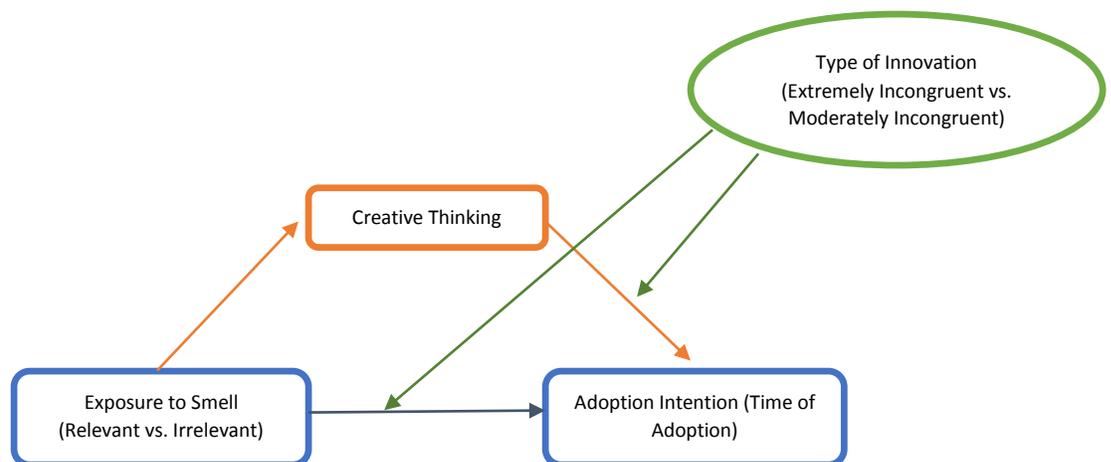


Figure 5: Conceptual Model – H2c

## **4.0 Study 1**

In this section, I aim to outline the procedure followed to test my research hypotheses (H1a and H1b) in a systematic manner. The purpose of study 1 is to test for the scents that strongly remind people of their childhood regardless of their valence.

### ***4.1 Participants and Design***

Undergraduate students were recruited from the MCS research pool at the University of Guelph. They were informed about this study through announcement posted on the SONA website, as well as, on their Courselink. Subjects were recruited to participate in this study in exchange for course credit as part of their research component grade in marketing courses. There was no restriction on participation based on the gender, age, or education level. However, there was a restriction on participants who were suffering from cold and blocked nose, and thus were unable to smell the stimuli and identify it in their full capacity. Participants were randomly assigned to one of the three conditions (Play-Doh, Citrus, and White Glue) following the pretest described in the next section.

### ***4.2 Scent Stimuli***

In a scent pretest, the prominence of the smell of Play-Doh was tested. The rationale behind selecting Play-Doh as primary condition is because it has been used as modeling compound by young children for art and craft projects at home and in school for more than 60 years. This pretest also aimed to identify the smells that are relevant and not relevant to childhood memories and playful experiences, and thus, can be used as secondary conditions. Fifty-four undergraduate students (39% female, mean age = 18.75 yrs.) to examine the prominence of the smell of Play-

Doh. The participants were provided with Play-Doh in a completely sealed container and asked to identify the smell. Following the identification, they were also asked to describe their memories associated with this smell (Willander and Larsson, 2006). 82% of the participants associated the smell with their childhood activities, and 86% of these participants accurately identified it as “Play-Doh.” This pretest also asked the participants to mention some other smells which relate to their childhood. Based on their responses, the smell of Citrus was selected as secondary condition due to its minimal association with childhood. The smell of White Glue was also added to the selection to control for the effects of other smells that are relevant to childhood experiences.

#### ***4.3 Dependent Measures and Procedure***

As part of the main study, participants were asked to smell one of the three sources of odorants (two relevant and one non-relevant). According to the procedure described by Willander and Larsson (2007), the odorants were placed in non-translucent plastic jars. The odorants were covered with cotton pads to prevent any visual inspection. The odorants were regularly replaced to ensure freshness. Participants were randomly assigned to one of the odorant condition and asked to sniff the assigned jar through the holes in the lid. Following the scale provided by Morrin and Ratneshwar (2003), participant were asked to rate the smell on pleasantness, likability and familiarity scale (nine-point semantic differential scale: 1=‘very unpleasant/not likable at all/not familiar at all’ to 9=‘very pleasant/likable/familiar’). The mean score of pleasantness and likability was used as the measure of valence. Higher score (>5) implied positive valence, and lower score (<5) implied negative valence. After providing the ratings on semantic differential scales, participants were also asked whether they can identify the odorant.

Then the participants were asked to write down the strongest memory relevant to the smell they encountered. The specific instruction was – “Please write down the strongest memory you have related to the odorant you just smelled. Please mention when the event occurred and describe it as elaborately as possible.” After completing the description, participants were asked to provide experiential rating to the memory recalled. Nine-point semantic differential scales were used that measured pleasantness, intensity, sense of being brought back in time, vividness, and emotionality of the memory. The cumulative score of these five dimensions was used to measure the feeling of mental time travelling (Willander and Larsson, 2007).

#### ***4.4 Data Analysis and Results***

Following the pretest for smell, one hundred and thirty four students (36.6% female; Mean age of 19.34 yrs.) were recruited to participate in study 1. They were randomly assigned to one of the three smell conditions (i.e. Play-Doh, White-Glue, and Citrus). Play-Doh and White Glue were categorized as relevant smell condition (association with childhood memories) and Citrus was categorized as irrelevant smell condition (no association with childhood memories).

Participants were asked to rate the smells on pleasantness, likability, and familiarity, as well as, to provide with the description and experiential ratings of the memories associated with these smells. For valence (mean score of pleasantness and likability), Play-Doh, Citrus, and White Glue had mean scores of  $M=5.44$ ,  $M=7.35$ , and  $M=4.13$ , respectively. For Familiarity, Play-Doh, Citrus, and White Glue had mean scores of  $M=7.55$ ,  $M=7.13$ , and  $M=6.25$ , respectively. For the feeling of mental time travelling, Play-Doh, Citrus, and White Glue had mean scores of  $M=5.79$ ,  $M=4.74$ , and  $M=5.46$ , respectively. In order to test whether these mean scores are significantly different from each other, a one-way ANOVA was conducted for the three odorants with valence,

familiarity, and feeling of mental time travelling as dependent measures. The F statistics were significant for all three dependent variables [valence,  $F(2, 131) = 61.452, p=0.000$ ; familiarity,  $F(2, 131) = 5.462, p=0.005$ ; mental time travelling,  $F(2, 131) = 7.256, p=0.001$ ]. These results are summarized in Table 2 and 3.

Table 2: Descriptive of Valence, Familiarity, and Mental Time Travelling

Variables	Smells	N	Mean
Valence	Play-Doh	44	5.44
	Citrus	46	7.35
	White Glue	44	4.13
Familiarity	Play-Doh	44	7.55
	Citrus	46	7.13
	White Glue	44	6.25
Mental Time Travelling	Play-Doh	44	5.79
	Citrus	46	4.74
	White Glue	44	5.46

Table 3: ANOVA

<i>Variable</i>	<i>F</i>	<i>Sig.</i>
<i>Valence</i>	61.457	0.000
<i>Familiarity</i>	5.462	0.005
<i>Mental Time Travelling</i>	7.256	0.001

Given, there was significant differences between at least two means for each dependent variable, multiple comparison between conditions revealed the mean differences for valence, familiarity, and mental time travelling. The result can be summarized as following.

Table 4: Multiple Comparison between Conditions for Valence, Familiarity and Mental Time Travelling

Dependent Variable	(I) Smell	(J) Smell	Mean Difference (I-J)	Std. Error	Sig.
Mental Time Travelling	Play-Doh	Citrus	1.04*	.28	.001
		White Glue	.32	.28	.796

	Citrus	Play-Doh	-1.04*	.28	.001
		White Glue	-.72*	.28	.033
	White Glue	Play-Doh	-.32	.28	.796
		Citrus	.72*	.28	.033
Valence	Play-Doh	Citrus	-1.90*	.29	.000
		White Glue	1.31*	.29	.000
	Citrus	Play-Doh	1.90*	.29	.000
		White Glue	3.21*	.29	.000
	White Glue	Play-Doh	-1.31*	.29	.000
		Citrus	-3.21*	.29	.000
Familiarity	Play-Doh	Citrus	.42	.40	.890
		White Glue	1.30*	.40	.005
	Citrus	Play-Doh	-.42	.40	.890
		White Glue	.88	.40	.084
	White Glue	Play-Doh	-1.30*	.40	.005
		Citrus	-.88	.40	.084

\* Significant at the level of 0.05

As shown in Table 4, the smell of Citrus was rated to have a significantly more positive valence (Mean Difference with Play-Doh=1.90, SE=0.29,  $p=0.000$ ; Mean Difference with White Glue=3.21, SE=0.29,  $p=0.000$ ) than other smells. The smell of Play-Doh had a less positive valence than that of Citrus, but a more positive valence than White Glue (Mean Difference with Citrus = -1.90, SE=0.29,  $p=0.000$ ; Mean Difference with White Glue=1.30, SE=0.29,  $p=0.000$ ).

In terms of familiarity, the smell of Play-Doh and Citrus did not differ significantly from each other (Mean Difference=0.42, SE=0.40,  $p = 0.890$ ). Between Play-Doh and White Glue, Play-Doh was found to have a more familiar smell than White Glue (Mean Difference=1.30, SE= 0.40,  $p=0.005$ ). However, White Glue was not found be much different from Citrus in terms of familiarity (Mean Difference= -0.88, SE=0.40,  $p=0.084$ ).

In terms of Mental Time Travelling, significant difference was observed between relevant smell (i.e. Play-Doh and White Glue) and irrelevant smell (i.e. Citrus) condition. Citrus was found

to be less stimulating in inducing the feeling of mental time travelling than both Play-Doh (Mean Difference=1.04, SE=0.28,  $p=0.01$ ) and White Glue (Mean Difference=-0.72, SE=0.28,  $p=0.033$ ). However, Play-Doh and White Glue were not found to be different from each other in terms of inducing the feeling of mental time travelling (Mean Difference=0.32, SE=0.28,  $p=0.796$ ).

A simple linear regression analysis [coded: relevant smell (Play-Doh and White Glue) = “1,” irrelevant smell (Citrus) = “0”] revealed significant main effects for both smells and their valence on the feeling of Mental Time Travelling ( $\beta = 1.455$ ,  $t(131) = 4.744$ ,  $p=0.000$ , and  $\beta=0.223$ ,  $t(131) = 2.921$ ,  $p=0.004$ ). However, from the test of moderation using PROCESS Model 1 (Hayes, 2012; Preacher, Rucker, and Hayes, 2007). The interaction between smell and valence was not found to be significant ( $\beta = -0.2188$ ,  $t(130) = -1.1248$ ,  $p=0.263$ ) (Table 5). Thus, as expected, support was found for H1a, but not for H1b.

Table 5: Model outcome of Mental Time Travelling (Relevant Smell)

	<i>Coefficient</i>	<i>Std. Error</i>	<i>t</i>	<i>Sig.</i>
<i>Constant</i>	1.8035	1.2449	1.3844	0.1686
<i>Valence</i>	0.4006	0.1750	2.2883	0.0237
<i>Relevant Smell</i>	2.9566	1.3695	2.1589	0.0327
<i>Interaction (Relevant Smell*Valence)</i>	-0.2188	0.1946	-1.1248	0.2628

Again, dummy variables using binary coding were created for Play-Doh and White Glue by taking Citrus as a baseline. Two separate tests of moderation for Play-Doh and White Glue were conducted using the PROCESS Model 1 (Hayes, 2012; Preacher, Rucker, and Hayes, 2007), in order to account for the bias in sample size [ $n=88$  for relevant smells (Play-Doh and White Glue) vs.  $n=46$  for irrelevant smell (Citrus)]. For both tests, interactions between valence and smells - Play-Doh and White Glue (with Citrus as base) were not found to be significant  $p=0.0787$  and  $p=0.4963$ , respectively. The results can be summarized as following.

Table 6: Model outcome of Mental Time Travelling using White Glue as Control Covariate

	<i>Coefficient</i>	<i>Std. Error</i>	<i>t</i>	<i>Sig.</i>
<i>Constant</i>	5.4156	0.4328	12.5140	0.0000
<i>Valence</i>	-0.0550	0.0707	-0.7780	0.4380
<i>Play-Doh</i>	-0.7295	0.8394	-0.8690	0.3865
<i>Interaction (Play-Doh*Valence)</i>	0.2571	0.1451	1.7724	0.0787

Table 7: Model outcome of Mental Time Travelling using Play-Doh as Control Covariate

	<i>Coefficient</i>	<i>Std. Error</i>	<i>t</i>	<i>Sig.</i>
<i>Constant</i>	5.2406	0.5878	8.9197	0.0000
<i>Valence</i>	0.0020	0.0886	0.0225	0.9821
<i>White Glue</i>	-0.2865	0.8975	-0.3192	0.7501
<i>Interaction (White Glue*Valence)</i>	0.1223	0.1793	0.6822	0.4963

Overall, findings from these above mentioned tests, support the hypotheses that smells that are relevant to childhood experiences will induce a stronger feeling of mental time travelling than those smell that are not relevant to childhood experience (H1a), regardless of their valence (H1b).

## 5.0 Study 2

Since expected results were found from study 1 (support for H1a, but not for H1b), the second study was designed to test for the effects of smell that serves as a strong reminder of people's childhood experiences on people's evaluation of highly innovative products (H2a). This study also aims to find the mediating effect of creative thinking on the adoption intention for these highly innovative products (H2b), as well as the moderating role of new product types on the hypothesized mediation effect (H2c).

### ***5.1 Participants and Design***

Undergraduate students were recruited from the MCS research pool at the University of Guelph. They were informed about this study through announcement posted on the SONA website, as well as, on their Courselink. Subjects were recruited to participate in this study in exchange for course credit as part of their research component grade in marketing courses. There was no restriction on participation based on the gender, age, or education level. However, similar to study 1, there was a restriction on participants who were suffering from cold and blocked nose, and thus unable to smell the stimuli and identify it in their full capacity. This study was conducted in a behavioural lab and all measure will be collected electronically. Given the results of scent pretest and study 1, the smell of Play-Doh and Citrus was retained as primary and secondary condition respectively to be used in this study.

Following this pretest, the second study incorporated a 3 (Scent: relevant, irrelevant, and control) x 2 (Product type: Extremely Incongruent and Moderately Incongruent) between subjects design. One hundred and fifty one participants (female 49%; Mean age of 19.26 yrs.) were randomly assigned to one of these six groups and asked to complete the study in three steps. First, they were asked to complete a product designing task with Play-Doh, which exposed them to the scent or no scent. Second, they were presented with either an “Extremely Incongruent” product or a “Moderately Incongruent” product and asked to evaluate them on various dimensions including their intended time of adoption. Third, they were asked to complete a problem solving task that measure their creativity (i.e. cognitive flexibility). Lastly, additional measures were taken in order to control for the external factors.

## ***5.2 Scent Stimuli***

From the results of Study 1, it was found that Play-Doh and Citrus are significantly different from each other in terms of their valence (Mean Difference = -1.90, SE=0.29,  $p=0.000$ ) and ability to stimulate the feeling mental time travelling (Mean Difference = 1.04, SE=0.28,  $p=0.001$ ). However, this two smells did not differ from each other in terms of perceived familiarity (Mean Difference= 0.42, SE=0.40,  $p=0.890$ ). Hence, both these smells were retained to be used in study 2.

## ***5.3 Product Stimuli***

Consistent with recent work exploring radical innovation as a violation of a product's core attribute (Bagga et al., 2016), I adopted stimulus material from the study conducted by Fangzhou Xu (2014) as part of her thesis at the University of Guelph. In her studies, she used “a bicycle without paddle” as core innovation, and “a bicycle with GPS navigation device” as peripheral innovation (Appendix 1). These two products were defined as “core innovation” and “peripheral innovation” respectively, and were found to support the schema congruity effect due to the manipulation of core versus peripheral attributes. Due to the significant difference observed in the mean score for perceived typicality, and functionality expectations for the two products (Xu, 2014), they were selected to be used in the main study.

## ***5.4 Dependent Measures for Evaluation of Innovative Products and Time of Adoption***

The participants were randomly provided with an image and description of either an “extremely incongruent” product (i.e. bicycle without paddle) and “moderately incongruent” product (i.e. bicycle with GPS navigation device). Participants were asked to rate the products on

their perceived typicality on three dimensions (is typical; is novel; is likely; anchored: 1=not much to 9=very much) (Campbell and Goodstein, 2001; Noseworthy, Finlay, and Islam, 2010; Noseworthy, Wang, and Islam, 2012). Another item was used to capture the functionality expectations of the product (ability to perform the functions of the target product category; anchored: 1=extremely poor; 9=extremely good) (Gregan-Paxton, Hoeffler, and Zhao, 2005; Noseworthy and Goode, 2011; Noseworthy, et al., 2012). These measures were used for manipulation check, to see whether these products were actually seen as “extremely incongruent” and “moderately incongruent” by participants while forming adoption intention.

Self-reported adoption time intents are argued to be the proxy for actual adoption times before launching the product or during the earlier stages of product life cycle (Islam, 2014). The underlying belief is that these self-reported intentions accurately represents people’s behaviour (Silk and Urban, 1978; Young, DeSarbo, and Morwitz, 1998; Ittersum and Feinberg, 2010) In order to measure the time of adoption, participants were asked to indicate how many years from now they are likely to adopt the target product, and the choices ranged from “six months from now” to “more than five years from now” with half a year interval between each option (Islam, 2014; Islam and Meade 2013; Marley and Islam 2012). To analyze the dependent measure of time of adoption, I ran a discrete time survival analysis, which typically focuses on time to event data (Islam and Meade 2011; Islam and Meade 2000; Meade and Islam 2010). Survival analysis models are most useful for positive-valued random variables. Ordinary least squares regression methods have limitations with this regard, since the time to event is typically not normally distributed, and without modification the model cannot handle censoring, which is very common in survival data. Generally, some subjects report to have censored times in survival model, in which case their event

times cannot be observed or do not take place until the end of the study. Unless this censoring issue is taken into account, it could create substantial bias in estimation of the timing of the event.

Since participants were asked to indicate how many years from now they would like to adopt the studied product, by ticking one of the time periods (each at six months interval) listed as the options (Islam and Meade, 2013) (anchored as 1 = “6 months from now,” 11 = “more than 5 years from now”), it is possible that participants who chose “11” may not adopt the product at all or delay it until a substantial period of time, say, 10 years. Hence, it is difficult to know how many of those participants who indicated “11” would never adopt the product. Although this analysis does result in loss of some information, this issue can be overcome through running Discrete Time Survival Model (DTSA).

### ***5.5 Operationalization of Creativity***

In order to test whether exposure to certain smells (i.e. Play-Doh) can facilitate creative thinking among participants, I incorporated the “Duncker Candle Problem” (Duncker, 1945) as the measure of creativity. Participants were shown a picture (Appendix 2) displaying several objects lying on a table: a candle, a pack of matches, and a box of tacks, all of which are next to a cardboard wall. The task asked participants to figure out a way to attach the candle to the cardboard wall, so that the candle burns properly without dripping wax on the table or on the floor. The correct solution for this problem is to use the box of tacks as a candle holder; the box of tacks needs to be emptied first, and then pinned to the cardboard wall with the candle inside. This solution to the problem is argued to be a measure of creative insight, since it involves using a typical object for an atypical purpose: the box of tacks can also serve as a candle holder, which is inconsistent with routinized cognitive scripts and behaviours (Duncker, 1945; Glucksberg and

Weisberg, 1966). Participants were told that this is a test for problem solving capability, and provided with a blank space right beneath the picture to type in the solution. For the correct solution, participants were assigned a score of “1” and for the wrong solution, they were assigned a score of “0.”

### ***5.6 Additional Measures***

Previous literature suggests an underlying relationship between consumer innovativeness and adoption behaviour. For instance, Midgley and Dowling (1978) outlined the difference between innovativeness and adoption behaviour, and argued that the relationship between this trait and behaviour is mediated by contextual and product specific factors, such as product involvement and resource constraint. Consumer innovativeness can be defined as underlying preference for new and diverse experiences (Carlson and Grossbart, 1985; Hirschman, 1980). In later study, Venkatraman and Price (1990) differentiated between cognitive and sensory innovativeness, and added to the argument that cognitive and sensory modes initiate different type of mental and physical activities, and differs across individuals’ demographic characteristics. They defined cognitive innovativeness as “the desire for new experiences with the objective of stimulating the mind” and sensory innovativeness as “the desire for new experiences with the objective of stimulating the mind” (Venkatraman and Price, 1990, p. 294).

Since, this study aims to explore the innovation adoption behaviour, it is deemed necessary to control for any difference that may arise due to individuals’ latent cognitive innovativeness and sensory innovativeness. Therefore, I adopted the 16 item scale used by Venkatraman and Price (1990) to measure cognitive and sensory innovativeness of participants. Some examples of the measure of cognitive innovativeness are “finding out the meaning of the words I don’t know,”

“thinking about different ways to explain the same thing,” etc. Some examples of the measure of sensory innovativeness are “Having a vivid dream with strange colors and sounds,” “dreaming that I was lying on the beach with the waves running all over me,” etc. Participants were provided with all 16 items in a random order (8 items for each construct of innovativeness) and asked to mention how likely they are to involve in those activities on a nine-point semantic differential scale (anchored: 1=“not likely at all” to 9=“very likely”).

### ***5.7 Method of Analysis: Time of Adoption as Dependent Variable***

To analyze the dependent variable of time of adoption (study 2), I ran a discrete time survival analysis, which typically focuses on time to event data (Islam and Meade, 2011; Meade and Islam, 2010). In the most general sense, it consists of techniques for positively valued random variable. This type of “time-to-event” data, however, may introduce a censoring problem. Failure to take censoring into account could produce serious bias in estimates of the timing of the event. For the purpose of this study, participants were asked to indicate how many years from now they would like to adopt the studied product, by ticking one time period listed in the answer (Islam and Meade 2013), with six months apart from each time option (anchored: 1 = “6 months from now” to 11 = “beyond 5 years from now”). Therefore, it is possible that participants who chose the time of adoption as “11” would like to delay their adoption up to 10 years or never adopt at all. This data was analyzed using a hazard model in order to overcome this censoring problem.

The event time  $T$  is always non-negative ( $T \geq 0$ ).  $T$  can either be discrete (taking a finite set of values, e.g.,  $(a_1, a_2, \dots, a_n)$ ) or continuous (defined on  $(0, \infty)$ ). In the current case, only the random variable  $X_i = \min(T_i)$  is observed ( $T$  = event time;  $U$  = censoring time). It is called right-

censoring since the true unobserved event is to the right of our censoring time. In addition to observing  $X_i$ , failure indicator was also checked for this process:

$$\delta = \begin{cases} 1, & \text{if } T_i \leq U_i \\ 0, & \text{if } T_i > U_i \end{cases}$$

For a sample size  $n$  drawn from the target population, there are observed value of covariates  $x_{i1}, x_{i2}, \dots, x_{in}$ , and possible censored survival times  $T_i$  for  $i$  subjects ( $i = 1, 2, \dots, n$ ). The equation for the model is as following:

$$\text{Log}(T_i) = \beta_0 + \beta_1 x_{i1} + \dots + \beta_n x_{in} + \sigma \epsilon_i$$

Here  $\beta_1, \beta_2, \dots, \beta_n$  are the regression coefficients of interest,  $\sigma$  is a scale parameter and  $\epsilon_i$  is the random error term, which is assumed to be independent and identically distributed with some density function  $f(\epsilon)$ . The equation for the survival time for the population is as following:

$$T_i = e^{\beta_0 + \beta_1 x_{i1} + \dots + \beta_n x_{in}} e^{\sigma \epsilon_i}$$

In this study, the mediation and moderated mediation effects of smell (Play-Doh vs. Citrus) on time of adoption through creativity were calculated by running a Sobel Test for the combination of the coefficient estimate of regressing Creativity on Play-Doh (controlling for Citrus) from binary logistic regression, and the coefficient estimate of regressing the Time of Adoption on Creativity (including Play-Doh and controlling for Citrus). From the discrete time survival analysis the equation for the censored survival model can be expressed as following:

$$\text{Log}(T_i) = \beta_0 + \beta_1 \text{Play-Doh} + \beta_2 \text{Creativity} + \beta_3 \text{Citrus} + \sigma \epsilon_i$$

$$T_i = e^{\beta_0 + \beta_1 \text{Play-Doh} + \beta_2 \text{Creativity} + \beta_3 \text{Citrus}} e^{\sigma \epsilon_i}$$

Here,  $T_i$  denotes the time of adoption for subject  $i$ . Play-Doh is the nature of smell to which participants were exposed to. It was coded as “1” when it was the smell of Play-Doh, and “0” when it was either the smell of Citrus or no smell. Creativity was measured by the accuracy of solution

for the Duncker Candle Problem (Duncker, 1945). It was coded as “1” when the solution was correct and “0” when the solution was wrong. Citrus was the covariate that was controlled for in the model. It was coded as “1” when the smell was of Citrus, and “0” when it was either the smell of Play-Doh or no smell.  $\sigma$  denotes a scale parameter and  $\epsilon_i$  denotes the random error term.

$\beta_2$ , the coefficient for Creativity in the model of Time of Adoption (after controlling for Play-Doh and Citrus) was used in combination with  $a_1$ , the coefficient for Play-Doh in the model of the Creativity (after controlling for Citrus), in order to test the indirect effect of Play-Doh on Time of Adoption through Creativity. To test the conditional indirect effect of Play-Doh on Time of Adoption through Creativity at the levels of the moderator (Type of Innovation),  $\beta_2$ , the coefficient for Creativity in the model of Time of Adoption, and  $a_4$ , the coefficient for the interaction between Creativity and Type of Innovation in the model of Time of Adoption (after controlling for Play-Doh and Citrus) were used.

## **5.8 Results**

### **5.8.1 Manipulation Check for Perceived Typicality and Functionality Expectations**

According to the literature reviewed in previous sections, extremely incongruent products are perceived to be less typical and expected to perform sub-optimally compared to moderately incongruent products, which in turn delays the adoption of such products. To test for the manipulation, participants were asked three questions for perceived typicality, and one question for expected functionality. Lower (higher) score on perceived typicality and functionality expectations would indicate the bike is being perceived as “extremely incongruent” (“moderately incongruent”).

The results for manipulation check was summarized in Table 8. The bike without paddle was perceived to be less typical ( $M_{EI} = 4.53$  versus  $M_{MI} = 5.68$ ;  $t(149) = -5.387$ ,  $p = 0.000$ ), and was expected to be less functional as a bicycle ( $M_{EI} = 4.64$  versus  $M_{MI} = 6.37$ ;  $t(149) = -4.904$ ,  $p = 0.000$ ) than the bike with GPS navigation device. Thus, it is assumed that, participants perceived the bicycle without paddle to be “extremely incongruent” and the bicycle with GPS navigation device to be “moderately incongruent.”

Table 8: Descriptive of Manipulation Check Results and t-tests

Scales	Product Type	N	Mean	t	Sig.
<i>Perceived Typicality</i>	Extremely Incongruent	76	4.53	-5.387	0.000
	Moderately Incongruent	75	5.68		
<i>Functionality Expectations</i>	Extremely Incongruent	76	4.64	-4.904	0.000
	Moderately Incongruent	75	6.37		

### 5.8.2 Main Effect of Smell on Time of Adoption

In this study, it was tested whether exposure to smell (relevant vs irrelevant) will affect how early people intend to adopt new products (extremely incongruent vs. moderately incongruent). It was anticipated that when exposed to the smell of Play-Doh, time of adoption will be relatively earlier for the new products than when exposed to the smell of citrus or no smell. A discrete time survival analysis using SAS code was conducted with Play-Doh as independent variable and Citrus as control.

Table 9: Parameter Estimates for the Main Effect Model

	B	SE	Wald	df	Sig.	Exp (B)	95% CI for Exp (B)	
							Lower	Upper
<b>Play-Doh</b>	<b>.637</b>	<b>.276</b>	<b>5.321</b>	<b>1</b>	<b>.021</b>	<b>1.892</b>	<b>1.101</b>	<b>3.251</b>
Citrus	-.057	.305	.035	1	.852	.945	.519	1.718

As summarized in table 9, I found a significant main effect of Play-Doh on the time of adoption for the new products ( $\beta = 0.637$ ,  $SE=0.276$ ,  $p = 0.021$ ). It indicates that people exposed to the smell of Play-Doh formed an earlier adoption intention for the new products than those who are exposed to the smell of Citrus or no smell. Thus, hypothesis H2a was supported.

However, when this main effect was observed at the level of product (“extremely incongruent” vs. “moderately incongruent”), it was found that only for moderately incongruent product the main effect of Play-Doh was significant ( $\beta = 0.952$ ,  $SE=0.414$ ,  $p = 0.021$ ) (Table 10). The main effect of Play-Doh for extremely incongruent product was not found to be significant ( $\beta = 0.341$ ,  $SE=0.375$ ,  $p = 0.363$ ) (Table 11).

Table 10: Parameter Estimates for the Main Effect Model (Moderately Incongruent Product)

	B	SE	Wald	df	Sig.	Exp(B)	95% CI for Exp (B)	
							Lower	Upper
<b>Play-Doh</b>	<b>.952</b>	<b>.414</b>	<b>5.294</b>	<b>1</b>	<b>.021</b>	<b>2.591</b>	<b>1.152</b>	<b>5.832</b>
Citrus	.504	.441	1.301	1	.254	1.655	.696	3.930

Table 11: Parameter Estimates for the Main Effect Model (Extremely Incongruent Product)

	B	SE	Wald	df	Sig.	Exp(B)	95% CI for Exp (B)	
							Lower	Upper
<b>Play-Doh</b>	<b>.341</b>	<b>.375</b>	<b>.826</b>	<b>1</b>	<b>.363</b>	<b>1.407</b>	<b>.674</b>	<b>2.936</b>
Citrus	-.619	.434	2.038	1	.153	.538	.230	1.260

Although, this result is counter-intuitive, it was further examined whether Play-Doh had a significant indirect effect on the adoption intention (time of adoption) for extremely incongruent products, since a significant “zero-order effect” of independent variable (exposure to smell) on dependent variable (time of adoption),  $r_{xy}$  is not necessary to observe a mediation effect (Zhao, Lynch, and Chen, 2010).

### 5.8.3 Mediation Effect of Creativity on Time of Adoption

In this study, it was also tested whether exposure to the smell of Play-Doh (vs. Citrus) will have a significant indirect effect on the time of adoption for new products. It was hypothesized that, exposure to the smell of Play-Doh (controlling for Citrus and no smell) will be more likely to facilitate creativity among participants, and this creativity will in turn induce people to form earlier adoption intention for those products. In order to test this hypothesis, first a logistic regression was run to estimate the coefficient of smell of Play-Doh in the model of creativity. Then, through discrete time survival analysis the coefficient of creativity in the model of time of adoption from the smell of Play-Doh and the creativity were calculated including the smell of Citrus as a covariate. The results can be summarized as following:

Table 12: Model Outcome of Creativity

	B	SE	Wald	df	Sig.	Exp(B)	95% CI for EXP(B)	
							Lower	Upper
<b>Play-Doh</b>	<b>1.554</b>	<b>.479</b>	<b>10.523</b>	<b>1</b>	<b>.001</b>	<b>4.731</b>	<b>1.850</b>	<b>12.098</b>
Citrus	.318	.514	.383	1	.536	1.375	.502	3.769
Constant	-1.634	.387	17.875	1	.000	.195		

Table 13: Model Outcome of Creativity on Time of Adoption

	B	SE	Wald	df	Sig.	Exp (B)	95% CI for Exp(B)	
							Lower	Upper
<b>Creativity</b>	<b>.672</b>	<b>.253</b>	<b>7.057</b>	<b>1</b>	<b>.008</b>	<b>1.959</b>	<b>1.193</b>	<b>3.218</b>
Play-Doh	.390	.294	1.764	1	.184	1.477	.831	2.627
Citrus	-.069	.305	.051	1	.821	.933	.513	1.697

As indicated in Table 12, exposure to the smell of Play-Doh had a significant main effect on creativity ( $\beta=1.554$ ,  $SE=0.479$ ,  $p=0.001$ ). It implies when exposed to the smell of Play-Doh participants were able to solve the ‘Duncker Candle Problem’ with high accuracy, than when exposed to other smell or no smell. As indicated from Table 13, when the measure of creativity

was included as a covariate in discrete time survival analysis, it had a significant main effect on the time of adoption ( $\beta=0.672$ ,  $SE=0.253$ ,  $p = 0.008$ ) for innovative products, than those in other conditions.

To test for the mediation effect, I ran Sobel Test through “Calculation for the Sobel test: An interactive calculation tool for Mediation tests” from the website of Kristopher J. Preacher (2015). The results obtained are summarized in Table 14.

Table 14: Test for Mediation Effect of Creativity in the model of Time of Adoption

	<i>Input</i>		<i>Test Statistic</i>	<i>Std. Error</i>	<i>Sig.</i>
<i>a</i>	1.554	<b>Sobel Test</b>	<b>2.0551</b>	<b>0.5081</b>	<b>0.039</b>
<i>b</i>	0.672	Aroian Test	1.9991	0.5223	0.045
<i>S<sub>a</sub></i>	0.479	Goodman Test	2.1162	0.4934	0.034
<i>S<sub>b</sub></i>	0.253				

As indicated by Table 14, creativity was found to fully mediate the relationship between the exposure to the smell of Play-Doh and the Time of Adoption ( $p = 0.039$ ). It implies that, when exposed to the smell of Play-Doh people demonstrated greater creativity in problem solving, and this facilitation of creativity induced people to form earlier adoption intention for new products. Thus, the hypothesis H2b was supported.

Although, the hypothesized mediation effect was found to be significant from running Sobel test, effect size for this mediation effect was also calculated to garner further support. Effect size has been defined as the “degree to which the phenomenon is present in the population or the degree to which the null hypothesis is false” (Cohen, 1988, p. 9-10). It has been argued that, the strength of the mediation effect should be based the effect size of the indirect effects, rather than mere presence of a direct effect (Zhao et al., 2010). However, the indirect effect does not fit the standard measures of effect size, such as standardized mean difference (Cohen’s *d*, Hedges’ *g*),

association ( $\beta$ ,  $r$ ,  $r_{bis}$ ), odd ratio, percentage of variance explained ( $R^2$ ,  $\eta^2$ ,  $\omega^2$ ), or the coefficient of variation (Preacher and Kelly, 2011).

One of the popular measures to calculate the effect size is the “Ratio Measures of Relative Magnitude” (Alwin and Hauser, 1975; MacKinnon, 1994; MacKinnon and Dwyer, 1993; Sobel, 1982). One of such measures that is relevant to the test of simple mediation models is the ratio of the indirect effect to the total effect,

$$P_M = \frac{ab}{ab+c'}$$

Here,  $a$  is the path from X (independent variable) to M (Mediator),  $b$  is the path from M (Mediator) to Y (Dependent Variable), and  $c'$  is the direct effect of X to Y.  $P_M$  is called the *validation ratio* (Freedman, 2001) or *mediation ratio* (Ditlevensen et al., 2005). It is also known as the *relative indirect effect* (Huang et al., 2004) and interpreted as the proportion of the total effect that is mediated. Given, the data for the mediation effect in this study ( $a=1.554$ ,  $b=0.672$ , and  $c' = 0.390$ ) the *mediation ratio* ( $P_M$ ) is calculated as following.

$$P_M = \frac{(1.554)(0.672)}{(1.554)(0.672)+(0.390)} = \frac{1.044}{1.434} = 0.7278$$

Given the sample size ( $n=151$ ), in order to calculate the confidence interval (95%) for the ratio, first of all, standard error of the mean ( $\delta_M$ ) was calculated using the following formula:

$$\delta_M = \frac{\delta}{\sqrt{n}} = \frac{\sqrt{(P_M)(1 - P_M)}}{\sqrt{n}} = \frac{\sqrt{(0.7278)(1 - 0.7278)}}{\sqrt{151}} = 0.0366$$

Then, the confidence interval (95%) was calculated using the following formula:

$$\begin{aligned} 95\% \text{ CI} &= [P_M \pm (1.96 \times \delta_M)] = [0.7278 \pm (1.96 \times 0.0366)] = [0.7278 \pm 0.0717] \\ &= [0.6483, 0.7917] \end{aligned}$$

This mediation ratio 0.7278 [95% CI (0.6483, 0.7917)] implies that creativity mediate approximately 73% of the total effect of smell on the adoption intention (time of adoption) for new products. The confidence interval indicates that this indirect effect is significantly different from zero at 5% level, since 0 is not included in the 95% confidence interval.

#### 5.8.4 Moderated Mediation Effect of Type of Innovation

The moderation effect of type of innovation was proposed in the final hypothesis (H2c), which stated that there will be a conditional indirect effect of smells (relevant vs. irrelevant) for different types of new product (“extremely incongruent” vs. “moderately incongruent”) on the time of adoption operating through the facilitation of creative thinking. It is expected that, people in Play-Doh condition will demonstrate higher creativity and thus, form earlier adoption intention for the “extremely incongruent” product than for the “moderately incongruent” product. However, in other conditions (Citrus and Control), people will demonstrate lower creativity, and thus, form earlier adoption intention for the “moderately incongruent” product than for the “extremely incongruent” product.

Table 15: Model Outcome for Time of Adoption

	B	SE	Wald	df	Sig.	Exp(B)	95% CI for Exp(B)	
							Lower	Upper
Play-Doh	.395	.295	1.800	1	.180	1.485	.833	2.646
Creativity	.664	.346	3.680	1	.055	1.943	.986	3.830
New Product Type	-.068	.303	.050	1	.823	.934	.516	1.692
<b>Interaction between Creativity and New Product Type</b>	<b>.009</b>	<b>.467</b>	<b>.000</b>	<b>1</b>	<b>.985</b>	<b>1.009</b>	<b>.404</b>	<b>2.517</b>
Citrus	-.060	.307	.038	1	.845	.942	.516	1.719

As indicated in Table 15, there was no significant interaction between Creativity and Type of product ( $p = 0.985$ ). For both type of new products (“extremely incongruent” vs. “moderately

incongruent”), creativity mediated the relationship between exposure to smell and adoption intention, such that exposure to the smell of Play-Doh resulted into earlier adoption intention, compared to other conditions (Citrus and control). Thus, the moderated mediation hypothesis (H2c) was not supported.

However, since the main effect of Play-Doh on Time of Adoption was not found significant in case “extremely incongruent” products, the mediation effect was examined further at product level. Through logistic regression in SAS, it was found that creativity has significant main effect on Time of Adoption for both “extremely incongruent” and “moderately incongruent” products, after controlling for smells (Play-Doh and Citrus) ( $\beta_{EI}=0.8372$ ,  $SE=0.371$ ,  $p = 0.024$ ;  $\beta_{MI}=0.7746$ ,  $SE=0.382$ ,  $p = 0.0427$ ). (Table 16 and 17).

Table 16: Model Outcome of Creativity on Time of Adoption (Extremely Incongruent)

<i>Parameter</i>	<i>DF</i>	<i>Estimate</i>	<i>SE</i>	<i>Wald Test</i>	<i>Sig.</i>
Intercept	1	-2.7679	0.2968	86.9733	<0.0001
<b>Creativity</b>	<b>1</b>	<b>0.8372</b>	<b>0.3710</b>	<b>5.0936</b>	<b>0.0240</b>
Play-Doh	1	0.0220	0.4149	0.0028	0.9578
Citrus	1	-0.7390	0.4482	2.7186	0.0992

Table 17: Model Outcome of Creativity on Time of Adoption (Moderately Incongruent)

<i>Parameter</i>	<i>DF</i>	<i>Estimate</i>	<i>SE</i>	<i>Wald Test</i>	<i>Sig.</i>
Intercept	1	-3.3679	0.3562	89.4218	<0.0001
<b>Creativity</b>	<b>1</b>	<b>0.7746</b>	<b>0.3823</b>	<b>4.1060</b>	<b>0.0427</b>
Play-Doh	1	0.7692	0.4550	2.8577	0.0909
Citrus	1	0.5708	0.4542	1.5794	0.2089

In order to test for the mediation effect, Sobel Test through “Calculation for the Sobel test: An interactive calculation tool for Mediation tests” from the website of Kristopher J. Preacher (2015) was run separately for extremely incongruent and moderately incongruent products. The results obtained are summarizes as following.

Table 18: Test for Mediation Effect of Creativity for Extremely Incongruent Product

	<i>Input</i>		<i>Test Statistic</i>	<i>Std. Error</i>	<i>Sig.</i>
<i>a</i>	1.554	<b>Sobel Test</b>	<b>1.8525</b>	<b>0.7023</b>	<b>0.064</b>
<i>b</i>	0.837	Aroian Test	1.7959	0.7244	0.073
<i>S<sub>a</sub></i>	0.479	Goodman Test	1.9148	0.6794	0.056
<i>S<sub>b</sub></i>	0.371				

Table 19: Test for Mediation Effect of Creativity for Moderately Incongruent Product

	<i>Input</i>		<i>Test Statistic</i>	<i>Std. Error</i>	<i>Sig.</i>
<i>a</i>	1.554	<b>Sobel Test</b>	<b>1.720</b>	<b>0.7001</b>	<b>0.085</b>
<i>b</i>	0.775	Aroian Test	1.664	0.7236	0.096
<i>S<sub>a</sub></i>	0.479	Goodman Test	1.782	0.6758	0.075
<i>S<sub>b</sub></i>	0.382				

As evident from Table 18, the indirect effect of smell on time of adoption through creativity was marginally significant ( $p = 0.064$ ) for the extremely incongruent product. This indirect effect, however, was not as prominent for the moderately incongruent product ( $p = 0.085$ ) (Table 19). These findings are marginally aligned with the proposition of this paper that facilitating creative thinking through exposure to the smell of Play-Doh (vs. Citrus) will have a more pronounced effect on adoption intention for extremely incongruent product than for the moderately incongruent product.

## 6.0 Discussion and Conclusion

### 6.1 Study 1

From the first study it was evident that, smells that are highly relevant to people's childhood experiences and playful activities, activate the cognitive scripts relevant to those experiences. People reported that when exposed to the smell of Play-Doh (relevant condition), they had a stronger feeling of being brought back in time (Mental Time Travelling), than when exposed to

the smell of Citrus (irrelevant condition). From pairwise comparison of means it was found that Play-Doh and Citrus both had relatively positive valence compared to White Glue (Mean Difference with Play-Doh=-1.30, SE=0.29,  $p=0.000$ ; Mean Difference with Citrus=-3.21, SE=0.29,  $p=0.000$ ). However, both Play-Doh and White Glue was found to stimulate stronger feeling of mental time travelling than Citrus (Mean Difference with Play-Doh = -1.04, SE=0.28,  $p=0.001$ ; Mean Difference with White-Glue=-0.72, SE=0.28,  $p=0.033$ ).

As expected, smell (relevant: Play-Doh and White Glue vs. irrelevant: Citrus) was found to have a significant main effect on the feeling of mental time travelling ( $\beta = 1.455$ ,  $t(131) = 4.744$ ,  $p = 0.000$ ), however, the interaction between smell and valence was not found to be significant ( $\beta = -0.2188$ ,  $t(130) = -1.1248$ ,  $p = 0.263$ ). It implies that regardless of a more positive valence, Citrus did not induce a strong feeling of being brought back in time compared to both Play-Doh and White Glue because of its lack of association with childhood memories. Thus, this study rules out valence as an explanatory factor in the equation of mental time travelling.

## **6.2 Study 2**

Previous literature posits that changes in cognitive performance, productivity, and judgement while exposed to ambient scents are largely due to the positive valence or positive mood effects associated with smells. Current study hypothesized that since some smells have particular associations with events in our life (i.e. childhood memories and playful activities), exposure to such smells are likely to unleash people's creative insight, and thus, affect the way people evaluate new products and form adoption intentions for them.

In this study, I found a significant main effect of smell on time of adoption for incongruent new products. People when exposed to the smell of Play-Doh indicated an earlier adoption

intention for these new products than those exposed to other smell (i.e. Citrus) or no smell ( $\beta = 0.637$ ,  $SE = 0.279$ ,  $p = 0.021$ ). This main effect was consistent across the level of new products (“extremely incongruent” and “moderately incongruent”) even after controlling for cognitive and experiential innovativeness of individuals.

To test for the mediation, I included the measure of creativity in the model of time of adoption, and it was observed that the path from Play-Doh to Creativity ( $a=1.554$ ,  $SE=0.479$ ,  $p=0.001$ ), and the path from Creativity to Time of Adoption ( $b=0.672$ ,  $SE=0.253$ ,  $p=0.008$ ) both were significant. When Creativity was included as a mediator in the model, the direct path from Play-Doh (after controlling for Citrus) to Time of Adoption ( $c=0.637$ ,  $SE=0.279$ ,  $p=0.021$ ), became insignificant ( $c'=0.390$ ,  $SE=0.294$ ,  $p=0.184$ ). The total effect ( $c$ ) thus can be defined through following causal models:

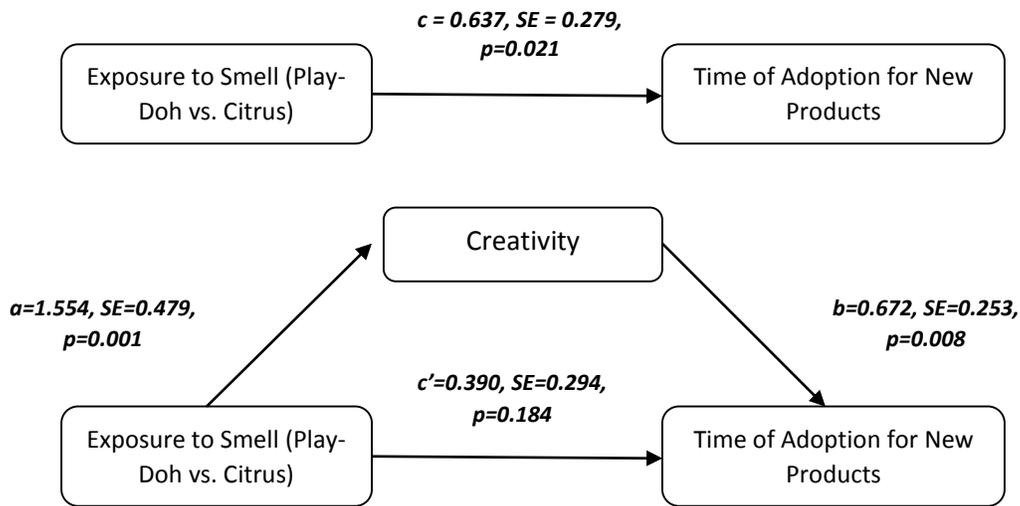


Figure 6: Causal Models for Direct and Indirect Effects

As illustrated in the figure above, that the total effect of exposure to smell (Play-Doh; after controlling for Citrus) on Time of Adoption for Innovative Products can be expressed as  $c = (a \times b) + c'$ . The total effect,  $c$  is the summation of indirect path ( $a \times b$ ) and direct path  $c'$  (Barron and

Kenny, 1986). In this current study,  $a=1.554$  ( $SE = 0.479, p = 0.001$ ),  $b=0.672$  ( $SE = 0.253, p = 0.008$ ),  $c'=0.390$  ( $SE = 0.294, p = 0.184$ ), and  $c=0.637$  ( $SE = 0.28, p = 0.021$ ). From Sobel Test, it was found that the indirect path ( $a \times b$ ) was significant. Thus, the causal model provides additional support that the effect of exposure to smell (Play-Doh) on Time of Adoption for new products is fully mediated by Creativity facilitated through such smell. However, it must be noted that, although Play-Doh did not have a significant main effect on time of adoption for “extremely incongruent” product, it was found to have a significant indirect effect on time of adoption through creativity. In this case,  $a=1.554$  ( $SE = 0.479, p=0.001$ ),  $b=0.8372$  ( $SE = 0.3710, p = 0.0240$ ),  $c'=0.390$  ( $SE = 0.294, p =0.184$ ), and  $c=0.341$  ( $SE = 0.375, p = 0.363$ ). From Sobel Test (Table 18), it was found that the indirect path ( $a \times b$ ) was marginally significant ( $p=0.064$ ). The causal model for direct and indirect effects for “extremely incongruent” can be illustrated as following (Figure 7).

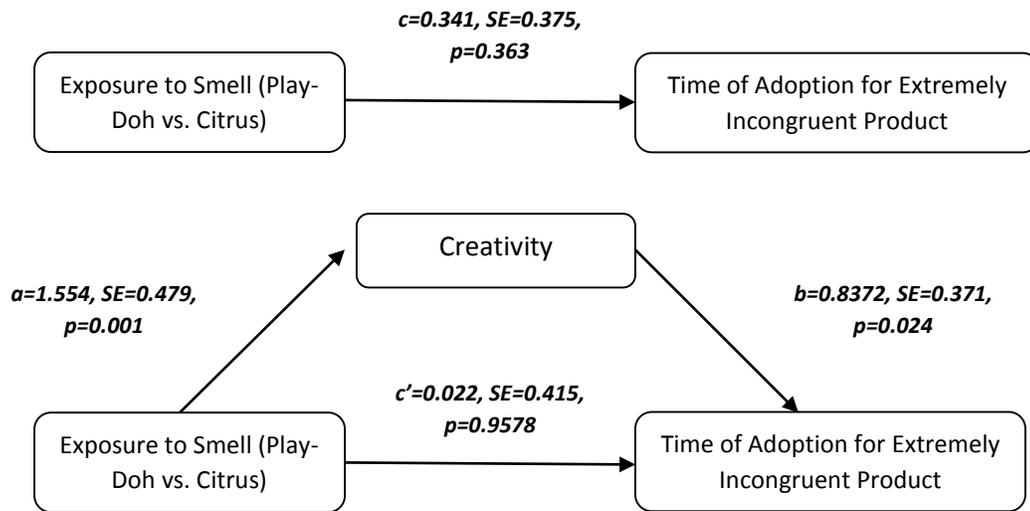


Figure 7: Causal Models for Direct and Indirect Effects (Extremely Incongruent Product)

On the other hand, for “moderately incongruent” product although there was a significant main effect on time of adoption, indirect effect on time of adoption through creativity did not

achieve significance. In this case,  $a=1.554$  ( $SE = 0.479, p=0.001$ ),  $b=0.7746$  ( $SE=0.382, p =0.043$ ),  $c'=0.7692$  ( $SE=0.455, p =0.091$ ), and  $c=0.952$  ( $SE=0.414, p=0.021$ ). From Sobel Test (Table 19), it was found that the indirect path ( $a \times b$ ) did not achieve significance ( $p=0.085$ ). The causal model for direct and indirect effects for “moderately incongruent” can be illustrated as following (Figure 8).

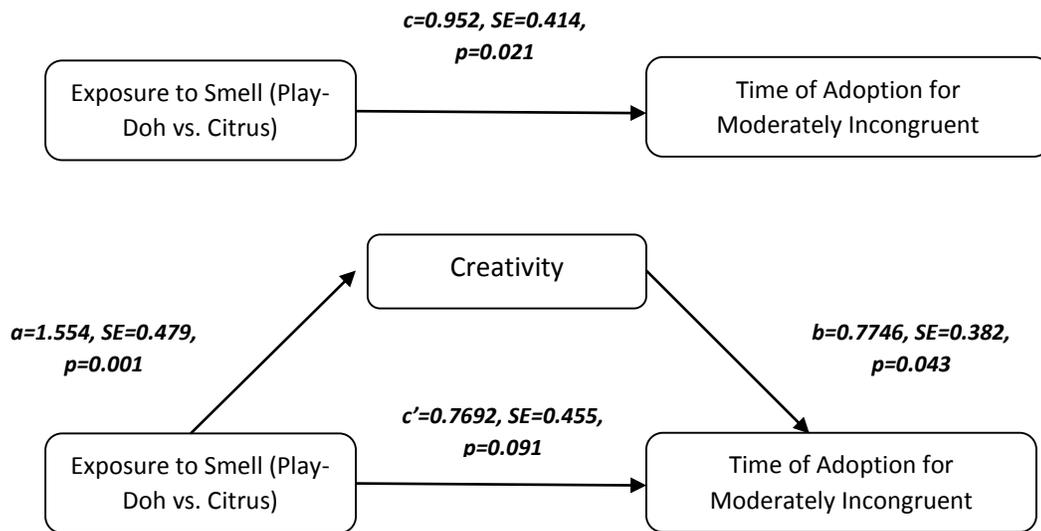


Figure 8: Causal Models for Direct and Indirect Effects (Moderately Incongruent Product)

Although, type of innovation was not found to be moderating the mediation effect, the findings are partially in line with propositions that generally people are less likely to adopt the “extremely incongruent” products when exposed to the smell of Play-Doh, than they are to adopt “moderately incongruent” product. However, when cognitive flexibility was attained due to the exposure to this smell, people formed earlier adoption intention for the “extremely incongruent product.” This finding is also in line with the proposition of Zhao et al. (2010), who argued that a significant “zero-order effect” of independent variable (exposure to smell) on dependent variable (time of adoption),  $r_{xy}$  is not necessary to observe a mediation effect. They argued that the “zero-order effect” of independent variable (X) on dependent variable (Y) substantiated by Baron and

Kenny (1986) is essentially the mathematical equivalence of the total effect [ $c = (a \times b) + c'$ ], the sum of the indirect path ( $a \times b$ ) and the direct path ( $c'$ ). Although the presence of a significant direct path is helpful in theorizing about other mediators, it should not serve as the basis of measuring the strength of a mediation. Rather, the strength of the mediation should rather be measured by the effect size of the indirect effect ( $a \times b$ ). Following the similar method for the calculation of mediation effect size (Alwin and Hauser, 1975; MacKinnon, 1994; MacKinnon and Dwyer, 1993; Sobel, 1982), it was found that - for the “extremely incongruent” product, creativity explained approximately 77% of the total effect (Mediation Ratio,  $P_M = 0.7679$  [95% CI (0.7294, 0.8092)]), although no significant direct effect of smell (i.e. Play-Doh; after controlling for Citrus) on adoption intention was observed.

## **7.0 Contributions, Limitations, and Future Research**

In this thesis, I examined the effect of smells that are relevant to childhood memories and playful activities on adoption intention for incongruent new products. I also investigated the mediation effect of creativity on time of adoption from the exposure to smells (relevant vs. irrelevant conditions). This section summarizes the theoretical contributions and possible managerial implications of this paper. It also outlines the limitations of the current research and directions for future research.

### **7.1 Theoretical Contribution**

Given, the hypothesized main effect and mediation effects are found from the studies, this thesis will contribute significantly toward existing literature on olfaction, consumer creativity, and innovation adoption behaviour.

First, this study examines a relatively underexplored dimension of olfaction or sense of smell. The thesis proposed that there would be an element of “mental time travelling” (Tulving, 1985) for each smell that humans encounter throughout their life. When exposed to different smells, it will activate the cognitive scripts and memories associated with itself, which will in turn affect the judgment and cognitive performance of individuals. From study 1, strong support was found in support of this proposition, and thus it adds to current understanding of sensory modalities (i.e. olfactory cues) and their connection to memories (i.e. episodic memories) and cognitive processes (i.e. creativity).

Second, this thesis also hypothesized that, such activation of cognitive scripts and facilitation of creative thinking would occur regardless of the valence of that particular smell. Extant literatures on olfactory cues only account for the positive mood effects and positive valence to explain the enhancements observed in people’s creative performance (Herz, 2002). The finding from study 1 effectively rules these alternate explanations.

Third, this thesis adds toward the consumer creativity literature. Existing literature predominantly focuses on the antecedents and consequences of creative insight (i.e. Burroughs and Mick, 2004; Moreau and Dahl, 2005; Sellier and Dahl, 2005; Hildebrand et al., 2013; Troye and Supphelen, 2013). Very few of them investigate the impacts of sensory modalities, let alone smell, on creative cognition. This study substantiates that priming with smells that are relevant to childhood memories, especially playful activities, can facilitate creative thinking without requiring any intervention from external environment.

Lastly, this thesis adds valuable insight for innovation adoption literature. Previous studies demonstrated the importance of facilitating cognitive flexibility, an integral part of creativity, for evaluation of incongruent new products (Jhang et al., 2012). It has been argued that when cognitive

flexibility is attained, people tend to form favourable evaluation for “extremely incongruent” products. In this current study, although the hypothesis for the moderated mediation effect of type of new products was not supported, it partially supports the findings of previous literature – creative thinking did facilitate forming earlier adoption intention for both “extremely incongruent” and “moderately incongruent products.” Future research could be directed toward investigating this phenomenon further, especially by incorporating “really new” products as stimuli since imaginative focus, a component of creative thinking, was found to effect the evaluation of such products more favourably compared to “incrementally new” products (Hoeffler, 2003; Zhao et al., 2009).

## ***7.2 Managerial Implications***

This study holds significant implications for the marketers of innovative products. As evinced by previous research, marketers are mostly preoccupied with exploiting two human senses – vision and audition (Lindstorm, 2005), a phenomenon that leads toward message clutter and noise in communication media, and fails to draw attention and generate awareness among target consumers. Although ambient scents are being used in retail contexts at an increasing rate, marketers only differentiate among those smells based on their congruence and valence to observe effects on mood and subsequent buying behaviour. Since, ambient scents (i.e. Play-Doh) that hold strong connection with past experiences (i.e. childhood and playful activities) are found to affect consumers’ thinking process through reactivation of episodic memories and associated cognitive scripts, manufacturers and marketers can use another dimension while deciding on using a particular smell in their products or in retail context.

Especially, the marketers and manufacturers of new products will be most benefited since activation of creative thinking results into favourable evaluation and earlier adoption intention for these products. On average a person breathes 20,000 times a day, and thus, each breath entails an opportunity to make a product salient in his mind (Stevens, 2006). Moreover, human olfactory system can distinguish among up to 10,000 different scents (Goldstein, 1999). No matter how trivial the trace of the scent is, it can engender awareness and recognition, and trigger memories and mental associations related to the scent (Lee, 2000). Therefore, it will require less explicit intervention from external environment and can be more easily implemented as a communication strategy.

### ***7.3 Limitations and Future Research***

The limitations observed in this study are mainly due to the size of the sample, composition of the sample respondents, limitations of scent stimuli, single product category usage, and limited measures of creativity. In this section, each of these limitations will be discussed in detail and corresponding improvements will be suggested for future research work.

First, this thesis used a total sample of one hundred and fifty one undergraduate students for study 2. To attain a high power (0.80) the required sample size was estimated to be more than 158. Due to time constraint and availability issues with respondents, the data was collected from 151 participants and achieved power was estimated to be 0.5358. It implies that, whenever there is an effect it can only be identified 53.58% of the time. This low achieved power potentially lead toward high standard error or noise in data, which in turn, might have reduced some significance of the model. Therefore, future research would be focused toward collecting more data and running the analysis again to test for any unobserved effects.

Second, this study entirely uses an undergraduate student sample (mean age 19.26 yrs.) to test for the current hypotheses. Due to limitation of time and availability issues, this study could not recruit participants across other age groups to represent the entire population. This representation is important since from autobiographical memory research it is evident that, older age groups have a reminiscent bump for the first decade of their life (i.e. childhood) when cued by olfactory stimuli (Willander and Larsson, 2007). It will be interesting to see whether for older age groups similar effects can be observed for creative cognition and adoption intention for innovative products.

Third, the smell that has been used in primary condition – Play-Doh may not remind of childhood and playful experiences equally across all age groups. Although Play-Doh has been a prominent craft and art toy since 1950, people from other age groups may have more salient associations with other smells (i.e. Crayon or White Glue) that are not explored in study 2. From study 1, it was found that the smells of Crayon and White Glue can also trigger strong feeling of being brought back in time, however, it is yet unknown whether they will facilitate creative thinking similarly as that of Play-Doh. Future research can be directed toward incorporating other relevant smells like Crayon and White Glue in the mediation model of the current study.

Fourth, due to constraint of time, I used a single category of product (i.e. bicycle) to test the hypotheses about innovative products in this study. To make the findings more valid, future research can include different categories of products to test the effects. Future research could also be directed toward incorporating the smell into the product itself or product packaging. It might also investigate the effect for “really new” products, which are difficult to be categorized into existing schema (Hoeffler, 2003; Alexander et al., 2008).

Fifth, this paper explored the effect of creativity on adoption intention for innovative products. Existing literature suggests, facilitation of cognitive flexibility lead toward incongruity resolution, which in turn affects the evaluation for incongruent products (Jhang et al., 2012). For future studies, it will be imperative to test for this mediation effect of incongruity resolution on adoption intention due to the exposure to smell and enhanced creative thinking.

Finally, due to constraint of time, I tested only for one dimensions of creativity, which is cognitive flexibility through the “Duncker Candle Problem” (Duncker, 1945). There has been several tests for measuring creative thinking, such as - Torrance Test of Creative Thinking (Torrance, 1974), Wallach and Kogan’s (1965) Test of Creativity, Guilford’s (1967) “Alternative Uses Task,” and so on. Future research can be directed toward investigating these dimensions as well, especially with the intention to see which dimensions of creative thinking can be activated through mental time travelling and how it will affect the evaluation of both existing and new products.

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## Appendix 1

### Product Stimuli



Extremely Incongruent Product  
(bicycle with no paddle)



Moderately Incongruent Product  
(bicycle with a GPS navigation  
device)

Appendix 2



The Duncker Candle Problem (Duncker, 1945)