Exploring the Boundaries of Embodied Cognition and Conceptual Metaphor Theory

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Declaration

This thesis contains no material that has been extracted in whole or in part from a thesis that I have submitted towards the award of any other degree or diploma in any other tertiary institution. No other person's work has been used without due acknowledgment in the main text of the thesis. All research procedures reported in the thesis received the approval of the Australian Catholic University's Human Research Ethics Committee (where required).

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Abstract

Embodied cognition is an approach to cognition which suggests that our bodies and their actions play a fundamental role in the processing of information including perception, planning, feeling, and even decision making. While research includes some strong theoretical work, there is a tendency in this literature to focus on novel effects and there is limited rigorous and systematic programs of inquiry. The current thesis endeavours to address this weakness of the literature by examining the boundaries and limitations of an established effect. This is achieved in this thesis by a meta-analysis, and two empirical studies designed to replicate and extend research on the embodied fishiness-suspicion conceptual metaphor. The results of the meta-analysis indicated that gustatory metaphor consistent embodied effects typically demonstrate moderate to large effect sizes in the predicted (i.e., metaphor consistent) direction. The findings from a broad range of bias tests suggest that these effects are generally robust to publication bias. The results of the first empirical study replicated the previous finding that incidental exposure to a fishy smell elicited suspicion related behaviour in line with the metaphor "something smells fishy". Consistent with the original experiments, exposure to a fishy smell undermined cooperation (i.e., Public Goods game; Lee & Schwarz, 2012), and improved performance in cognitive decision making (i.e., Wason Rule Discovery Task; Lee et al., 2015). In addition to the replication predictions, it was predicted that certain traits (i.e., distrust) would interact with the embodied effects (i.e., fishy smell) on the various outcome variables (i.e., Public Goods Game/social trust), unexpectedly it was found was that the embodied effects were sufficient to override the traits that were measured. The final study examined the effect of using visual fishiness cues instead of olfactory ones in the fishiness-suspicion paradigm. I predicted that I would find results consistent with the previous research (i.e., Lee et al., 2015; Lee & Schwarz, 2012), and my first empirical study. However, the results failed to support my hypotheses. The discussion focusses on the implications of these findings, and suggestions for future research.

Chapter 1 : Thesis Overview

Empirical research in embodied cognition has rapidly increased over the past two decades (for a review; Landau et al., 2010). However, most of this research tends towards descriptive rather than explanatory works, resulting in breadth but limited depth in this literature. Few attempts have been made to explore, replicate, or develop a theoretical explanation of these effects (Meier, Schnall, et al., 2012). For example, "metaphorical effects tend to be cute and newsworthy enough to elicit a 'wow', but less is known about their 'how'" (Lee, 2012, p. 13). The current thesis will address this weakness by focussing on a single embodied conceptual metaphor, evaluating evidence, undertaking replication, and then examining a potential limit of the effect.

This thesis will focus heavily on metaphor consistent embodied cognition effects, and more specifically the perceptual-conceptual link between fishy smells and suspicion as first demonstrated by Lee and Schwarz (2012). Their study was designed to explore the effect of perception (i.e., perceived fishy smell) on trust, via the concept suspicion (i.e., that's "fishy"). Participants for this study were recruited in the hallways of their college dorms, which were sprayed, prior to the experiment, with either fish oil, fart spray (i.e., unpleasant but metaphorically irrelevant), or water (i.e., a control condition). Participants were given an endowment (i.e., $5) and then told that they could keep the money or "invest" up to 100% of it in a communal fund (i.e., consisting of ten participants) that was guaranteed to be multiplied by a factor of 1.8 (i.e., every $1 invested would become $1.80). The total sum of multiplied investments would then be distributed equally among all members of the participant group. Any money not invested would be kept by the participant, so they would receive their non-invested money and their share of the communal fund. Economically, the best outcome for the group results from all participants investing the full amount (i.e., each participant receives one-tenth of 10 x 1.8 x $5, which is $9). However, for any one participant, it is better not to invest provided everyone else invests (i.e. the defector receives a total of $5 plus one tenth of

9 x 1.8 x $5, which is $13.10). Furthermore, if a participant believes that others will not contribute equally, they should reduce the size of their investment (increasing the size of their non-invested portion). Thus, this task is a measure of trust. Consistent with embodied cognition predictions, participants who completed this public goods game in the fishy smelling hallway invested less money than those in the other conditions, with no statistical difference between investments found for the fart spray and water conditions. Thus, these findings suggest that it was not the unpleasantness of the odour that led to decreased trust. Rather, the effect was unique to the fishy smell. This effect was conceptually replicated by the researchers across several separate studies that will be discussed in more depth later in this thesis. Below is a broad overview of the core chapters that constitute this dissertation.

Chapter 2 presents a review of the traditional theories of cognition (e.g., Newell & Simon, 1972) and embodied cognition (e.g., Barsalou, 1999), and how the field of embodied cognition has developed. Limitations of both the traditional views, and the embodied view will be examined. The chapter will also discuss, define, and describe the development of conceptual metaphor theory (e.g., Lakoff & Johnson, 1999), and how this integrates with embodied cognition. This chapter will also identify key limitations and areas for future research that may provide further knowledge and understanding to the existing literature on embodied cognition and conceptual metaphor theories.

Chapter 3 presents a meta-analysis of the empirical research on metaphor-consistent embodied cognition effects directly primed via the gustatory senses (taste and smell) was conducted in order to determine the strength and consistency of these effects. The meta-analysis (N = 1334, k = 19) also included a comprehensive range of bias tests to further test the robustness of the findings. Separate analyses were conducted for studies with a neutral control condition (i.e., water), and studies with a comparator condition (i.e., fart spray used to control for a factor such as valence). The results from the analysis also informed the design of the empirical studies.

Chapter 4 provides a brief link between the meta-analysis and the empirical studies that are included in this thesis. This chapter also introduces the innovative contributions to the topic and thesis.

The first empirical study (Chapter 5) is a conceptual replication of two previous studies examining the previously demonstrated embodied effects of a fishy smell on social decision making (Lee & Schwarz, 2012), and cognitive processes (Lee et al., 2015) designed to induce suspicion via the conceptual metaphor "something smells fishy". The aim of this study was first to test if this specific effect is present in an Australian sample, as this has not been tested outside of the U.S., and, more specifically, outside of the laboratory that conducted the original studies (University of Michigan). This study also included measures of personality in order to examine the potential interaction between embodied effects and individual differences.

The final study examined the effect of using visual fishiness cues instead of olfactory ones in the fishiness-suspicion paradigm (e.g., Lee & Schwarz, 2012). Chapter 6 presents the piloting of cross-modal priming stimuli (e.g., visual images rather than scents) to be used in the final study. This chapter discusses the minimal research available on priming metaphor consistent embodied effects across sensory modalities (e.g., Levontin et al., 2015; Slepian et al., 2014), and how they informed the design of the images created, and the methodology used to test for potential effects.

Chapter 7 will present the final study of this thesis. Based on the reviewed literature I expected to find similar yet weaker effects, to previous research (i.e., Lee et al., 2015; Lee & Schwarz, 2012), and my first empirical study, due to priming occurring outside the primary modality consistent with previous cross-modal research (e.g., Levontin et al., 2015; Park & Hadi, 2020; Rai et al., 2017; Shalev, 2014, 2016). Demonstration of attenuated cross-modality priming of a scent-based metaphor via visual stimuli would firstly provide further support for

the multimodal nature of embodied cognition and secondly provide the necessary evidence to allow the exploration of this metaphor with online samples.

Chapter 8 presents the general discussion for this thesis including a review and integration of all findings. The aim of this chapter is to consider findings in relation to the boundaries of embodied cognition and conceptual metaphor theory (e.g., Barsalou, 1999; Lakoff & Johnson, 1980), and involves some re-visiting of findings from the previous chapters. The limitations and conclusions of each study will be discussed on their own, and taken together, before presenting the general implications and future directions in its entirety.

While there is a growing body of empirical research demonstrating the fascinating and intriguing effects of embodied cognition, as yet there has not been a great deal of investigation into the limits of the effects. It is not clear under what contexts these effects occur, or when and where they can be expected. The research proposed here was designed to consider some of these problems by investigating the extent to which the observed effects may be generalised across modalities and cultural differences. Further, it will investigate the delimiting conditions for the effect by testing whether the effects may be moderated by relatively stable personal characteristics. Moreover, I will undertake all of this by focussing on a single conceptual metaphor, namely, the metaphoric transfer effects between fishy smell and suspicion as previously demonstrated by Lee and Schwarz (2012).

Chapter 2 : Introduction and Theoretical Background

Embodied cognition is an approach to cognition which suggests that our bodies and their actions play a fundamental role in the processing of information including perception, planning, feeling, and even decision making (Barsalou, 1999; Wilson & Golonka, 2013). An example of the role of sense-based information affecting cognition was demonstrated by the finding that participants holding a warm cup of coffee reported more positive (i.e. “warm”) impressions of a stranger, than those holding a cold cup of ice coffee (Williams & Bargh, 2008). This effect occurred without the participants' conscious awareness, which cannot be easily explained by traditional cognitive theories (e.g., semantic priming; McNamara, 2005).

One prediction of embodied cognition is that even incidental exposure to sensory stimuli (e.g., smell, taste, touch, and vision), can influence cognition via the activation of embodied concepts which purportedly form the basis for abstract concepts (Glenberg et al., 2013). For example, early research demonstrating that participants wearing a heavy (versus light) backpack perceived slopes to be steeper (i.e., Bhalla & Proffitt, 1999), while similar effects of wearing a heavy (versus light) backpack has been found to lead to less guilt inducing behaviour (i.e., choosing healthy snacks over chocolate; Kouchaki et al., 2013). These findings demonstrate that the abstract concepts of both difficulty and guilt can be activated via the physical experience of heaviness (i.e., being burdened with a weight; Kouchaki et al., 2013). Further evidence for this proposition has been found with sensory experiences affecting judgments of trustworthiness (via scent; Lee & Schwarz, 2012), justice (via vision; Zarkadi & Schnall, 2013), feelings of loneliness (via taste; Troisi & Gabriel, 2011), and aggression (via touch; Hess & Gryc, 2013).

In recent years, embodied cognition has been applied to topics across a broad range of disciplines including social psychology (Ackerman et al., 2010), artificial intelligence (Ballard et al., 2013), robotics (Trafton et al., 2013), marketing (Krishna, 2012), education (Chang et al., 2013), psycholinguistics (Gibbs, 2003), neuroscience (Damasio & Damasio,

1994), and philosophy (Shapiro, 2007), providing a unique theoretical framework that allows the re-conceptualisation of these effects from seemingly disparate topic areas using a common approach, and demonstrating widespread acceptance outside of mainstream psychology. Before reviewing findings from this literature, it is useful to consider the key differences between embodied cognition and the traditional cognitive approaches, especially in relation to mental representation and associated processes.

Review of Traditional Views of Cognition

The emergence of cognitive psychology as a recognised subdiscipline of psychology in the 1950s has been closely tied to the development of personal computing and advances in artificial intelligence (Goldstein, 2011). Specifically, the computer offered a plausible metaphor of the mind (i.e., mind-as-information processor) that worked on inputs (e.g., sensory information) and, following the processing of information conveyed by these inputs, produced an output (e.g., behaviour; Casey & Moran, 1989). In addition, computers also provided a new way to investigate this model of mind (i.e., computer simulation; Casey & Moran, 1989). Thus, the information processing account of human behaviour, emotions, and cognitive processes was born (David et al., 2004).

A consequence of conceptualising the mind as an information processor was the reinforcement of the earlier mind-body dualism often attributed to Descartes (e.g., Duncan, 2000). For example, separating the metaphorical hardware (e.g., body, environment) and software (e.g., mind). A logical conclusion of this is the claim that a fully functional conceptual system will be distinct from sensorimotor mechanisms and, by necessity, will be amodal (i.e., a metaphorical central processing unit; Niedenthal et al., 2005). The major weakness of an information-processing account is that sensory-motor information is essentially viewed as hardware input, which is “transduced” (Fodor & Pylyshyn, 1988), into amodal symbolic representations that are only arbitrarily related to the perceptual state from which the input originated (i.e., decoupled from the sensory motor systems; Morgan, 2018).

According to an information processing account, transduction occurs any time a physical/bodily state is experienced (David et al., 2004; Newell & Simon, 1972). Transduction, in this case, is the process of changing sensory input (like the sound of a dog's bark) into an amodal symbol, which is then added to a mental representation of the category (e.g., "dog": bark, fur, tail, wag, paws, etc; Ignatow, 2007). When the category is activated, only the (now) amodal representation is used, as the sensory modalities are presumed to be neither involved nor necessary (Fodor & Pylyshyn, 1988).

Traditional Cognitive View of Mental Representation

Mental representation is the term used to describe units of information that are stored in memory (Pylyshyn, 1984). However, mental representations are not static (e.g., like a photograph). They are dynamic constructs that allow individuals to acquire, store, and mentally manipulate information (Yee et al., 2013). This complex concept can easily be demonstrated by a simple thought experiment. For example, as you read about an object such as a blanket, you can easily bring to mind an image of that object including its features, uses, and any strong personal associations you have with this type of object. This exercise can be used to demonstrate three of the main traditional views of mental representation. The prototype view of mental representation posits that what is stored is a most typical example of the target (i.e., a stereotypical blanket; Goldstein, 2011). This view accounts for findings of substantial similarity between individual's mental representations within a culture. The prototype view predicts that people will think of a pigeon-like bird rather than a penguin-like or emu-like bird when picturing a "bird" (Goldstein, 2011). In contrast, the exemplar view provides a better account of findings that an individual's mental representations reflect actual, often personal examples (e.g., you may have thought of the blanket on your bed in the thought experiment; Goldstein, 2011). However, as can be seen from these examples, neither view parsimoniously accounts for the different outcomes when an individual's exemplar deviates from the prototype.

The schema view (Brewer & Treyens, 1981) accounts for both common (e.g., prototype) and individualistic (e.g., exemplar) features, as well as explaining some effects of context. For example, your representation of a blanket will likely vary depending on the context (e.g., whether you were thinking about a blanket in a bedroom or at a picnic). This is achieved by the idea of a concept map (i.e., schema) which stores all concept-relevant information and allows context-relevant priming to affect what is accessed.

All these traditional cognitive views (e.g., prototype, exemplar, schema), share one fundamental property: regardless of the nature of the information that is experienced, the representation of this information and its components are all stored as abstract symbols. That is, while you can visualise a blanket, and even imagine its weight, softness, and warmth, this seemingly sensory information, which was acquired through sensation, is stored at the level of representation amodally. This theoretical assumption leads to the two major drawbacks of traditional cognitive views of mental representation. Firstly, while traditional views posit that all perceptual information is transduced into arbitrary amodal symbols, they cannot explain how, where, or when, this process occurs. This is known as the 'transduction problem' (i.e., how sensory information becomes pure amodal information, and how this amodal information reverts to sensory information; Rugg & Thompson-Schill, 2013), and remains unresolved (Barsalou, 1999). The other drawback is known as the symbol grounding problem.

The symbol grounding problem (Harnad, 1990) is quite often explained using Searle's (1980) Chinese Room thought experiment. An English-speaking individual, who knows nothing about either written or spoken Chinese is locked in a room. A bundle of papers containing Chinese symbols is passed through a slot in the wall to the individual. To the individual these are just meaningless squiggles. Another bundle is then passed through the slot, but on these papers are the written (in English) rules for responding to the Chinese symbols (e.g., 注音標示). The responses then need to be made in Chinese symbols. After a period of time, the individual can learn to correctly respond to the Chinese symbols by

successfully following the provided rules. To an observer outside of the room it appears that the individual can understand Chinese. But this would be an inaccurate conclusion because the responses do reflect knowledge or understanding of any content.

The Chinese Room thought experiment demonstrates that symbols do not acquire their meaning based on their relationship to other symbols. Moreover, Searle's (1980) work exposes a key limitation of the traditional cognitive views of representation which claim "that computations in the mind involve rule-governed manipulation of symbols according to their syntactic relationship to other symbols, not according to their meaning" (Cash, 2015, p. 14). This results in what Harnad (1990) refers to as an endless merry-go-round, and concludes that "cognition cannot be just symbol manipulation" (p. 339).

In summary, traditional cognitive views of mental representation posit stored information has been transduced from modal inputs (e.g., sound, light, taste) into a common language of arbitrary, abstract, amodal symbols. An interesting and testable consequence of this proposition is that the activation of any mental representation, regardless of whether it refers to one modality or another, is therefore equivalent. That is, once transduced, there should be no differential processing associated with accessing symbols that were originally acquired from different modalities.

Embodied Cognition

The embodied cognition approach rejects the notion that mental representations are arbitrary or amodal (Barsalou, 1999). Instead, representations are locally-stored fractions of experience (Damasio & Damasio, 1994). For example, if a new smell is encountered, a small fraction of the information is stored or represented within the olfactory area's associative cortex in the brain. A similar process is thought to occur for each of the perceptual senses (taste, smell, vision, touch, audition), as well as for our gestures, actions, and movements (e.g., proprioception; Barsalou, 2008). This leads to a wide variety of modality (i.e., sensory) specific symbols that map directly onto the physical interactions with our environment on

which they are based. Moreover, this means that the representations involve a range of bodily systems (Amin et al., 2015). This is in direct contrast to traditional cognitive views which posit that peripheral inputs are separate from, rather than intrinsic to thoughts and behaviour. In sum, embodiment suggests that the body and its actions are central to the embodied cognitive process in a clear departure from Cartesian dualism (Dempsey & Shani, 2012).

The embodied approach addresses both weaknesses of traditional cognitive approaches to mental representation, namely, the problems of symbol grounding and efficiency. Specifically, from this perspective, any mental representation involves those areas of the brain that were initially activated when the mental representation was formed (Barsalou et al., 2003). For example, the mental representation of "grasping" is initially formed through the actual physical action of reaching for an object. Consequently, any subsequent thoughts about this action which can be provoked by a memory of grasping, a need or plan to grasp, or even simply by reading the word "grasping", causes a similar pattern of neural activation allowing a partial-re-experiencing of the physical event and any related stored information (e.g., visual representation of the word, maybe the sound of effort made when grasping, and all relevant sensory and motor information). In this way, a mental representation is multimodal, embodied. and more efficient, as it requires no conversion to (or transduction), or storage of arbitrary symbols. Rather than symbols deriving their meaning from their relationship to other symbols (traditional cognition view), here the symbols are grounded in perception and action and become meaningful in themselves (Barsalou, 1999).

Evidence for multimodal representation is demonstrated by functional magnetic resonance imaging (fMRI) research showing body specific activation of neural areas when listening to action sentences (e.g., Tettamanti et al., 2005). For example, neural regions related to the hand (i.e., left precentral gyrus) were more active when listening to hand related action sentences, than when listening to mouth, or leg, action sentences, and similarly mouth regions (i.e., inferior frontal gyrus) most active when listening to mouth related sentences, and

leg regions (i.e., superior frontal sulcus) most active when listening to leg action related sentences (Tettamanti et al., 2005). Furthermore, when reading manual-action verbs (e.g. grasp) the motor cortex associated with the physical behaviour (i.e., manually grasping an object) become active (e.g., Willems et al., 2010). This activation is even specific enough to demonstrate handedness preference (i.e., greater activation of the dominant hand which is used to grasp; Willems et al., 2010). Similarly, reading the words “lick”, “pick”, or “kick” has also activated the language centres of the brain and those specific sensorimotor areas associated with the tongue, fingers, and leg, respectively (Hauk et al., 2004). Further evidence has also been provided by neuroimaging studies that have found that reading a word that is related to a sensory experience activates the relevant brain region. For example, reading “cinnamon” has been found to activate olfactory brain regions (Rueschemeyer et al., 2009).

Taken together, the neuroscientific evidence strongly supports the claim for modality-based representations are stored in modality specific related areas in the brain. This is very clear support for the embodied cognitive proposition that mental representations comprise information from a variety of sensorimotor systems and are, therefore, multimodal (Hauk et al., 2004). These findings also suggest that modal information, whether it is also transduced or not, is not lost in translation, providing strong evidence against traditional cognitive views of mental representation.

For concrete or physical concepts, it is quite easy to understand how mental representations can be grounded in experience as they have clear physical referents (Barsalou et al., 2003). For example, the concept dog is concrete as it consists of the integration of many experiences through multiple senses. However, for abstract concepts that are not directly experienced by the senses it less clear how these representations (i.e., perceptual symbols; Barsalou, 1999) can be accounted for from an embodied cognition perspective. For example, the concept justice is not directly perceived by the senses (i.e., it cannot be smelled, tasted, seen, touched, or heard), so it is not readily apparent how this concept can be modally stored

(Borghi et al., 2017). This has been considered a major challenge, and key limitation, of embodied cognition theories (Eskine, 2011).

Many sceptics of embodied cognition theories continue to contend that embodied theories fail to provide a coherent account of the representation of abstract concepts that clearly include sensorimotor grounding (Dove, 2016). Embodied cognition opponents suggest that this drastically reduces the scope of embodied theories and is thus referred to as 'the scope objection' (Löhr, 2019) or 'the symbol ungrounding problem' (Dove, 2016). This is considered quite restrictive as abstract thought and reasoning is a key sophisticated ability of the species, and any comprehensive theory would need to account for higher-order cognition (Borghi et al., 2017).

Embodied cognition is a broad umbrella term, and the specific theories under this are not in complete and consistent agreement across all propositions. Therefore, a variety of responses and potential solutions to 'the scope objective' have been offered by several key embodied cognition researchers (i.e., Barsalou & Wiemer-Hastings, 2005; Borghi et al., 2017; Lakoff & Johnson, 1999). Responses to this objective can generally be differentiated on whether concrete and abstract concepts are seen as very similar, or as a discrete dichotomy (i.e., can be either/or but not both; Borghi et al., 2017)). Embodied cognition theorists that view concrete and abstract concepts as similar claim that both concrete and abstract concepts are grounded in sensorimotor experiences and can be classified along a continuum. For example, Barsalou and Wiemer-Hastings (2005) have demonstrated that situational context is central to the description of both concrete and abstract concepts, indicating their similarities, and suggesting both are grounded in perceptual experience. In contrast, proponents of conceptual metaphor theory (Lakoff & Johnson, 1980) argue that abstract concepts are based on their mapping from concrete/sensory experience, via metaphors. For example, justice can be described as blind and balanced. Thus, in response to the 'scope objective' it has been argued "that abstract concepts are understood by placing them in concrete knowledge

domains, and that this mapping guarantees their grounding" (Borghi et al., 2017, p. 8). From this perspective there is a distinct difference between the concepts, but what is not physically tangible (abstract) can be conceptualised, or understood, in terms of what is physically tangible (concrete).

In sum, embodied cognition theories offer a seemingly simple solution to two of the major challenges to traditional cognitive models of mental representation. For this reason, and based on growing empirical support, embodied cognition has gained much interest and acceptance in psychological research (i.e., Farina, 2020).

Conceptual Metaphor Theory

The study of metaphor is considered to have originated with the works of Aristotle (ca. 335 B.C.E./ 2006) who defined metaphor as a linguistic device identifying similarities between dissimilar things to aid in understanding (Landau, 2016). In other words, a metaphor is a figure of speech in which a word or phrase is used to describe something it is not literally applicable to (e.g., "love is a journey"; McGlone, 2007). Aristotle considered the usage of metaphors to be a skill, or an indication of language mastery, but viewed these figures of speech as merely ornamental or poetic leading to the traditional view that "metaphor is a figure of speech, a fanciful and deliberate decoration and bells and whistles of a poet" (Vakhovska, 2018, p. 86). This relegation of metaphor to simply stylistic comparisons resulted in further study of metaphors being largely ignored outside of literary domains (McGlone, 2007). This comparison view remained undisputed right up to the end of the 19th century until linguists such as Breal (1899, as cited in McGlone, 2007), Richards (1936, as cited in McGlone, 2007), and Black (1962, as cited in McGlone, 2007) argued that metaphors are not merely ornamental literary devices but ubiquitous and pervasive in common language usage (i.e., Cameron, 2003). However, it was not until a clear formulation provided by Lakoff and Johnson (1980) in their book Metaphors We Live By that a resurgence of interest and study of metaphor from broad domains occurred (Landau, 2016).

Conceptual metaphor theory is largely based on the work of Lakoff and Johnson (1980). They contest that our conceptual system develops through physical experiences as we interact with the surrounding world. “we form image-schemas, knowledge gestalts that emerge out of repeated and pattern sensorimotor experiences” (Amin et al., 2015, p. 751). In other words, our knowledge of simple to complex concepts is formed through our perceptual experiences. In simple terms, metaphors are figures of speech that allow an understanding of one concept in terms of another. Within social psychology metaphors have provided a means of exploring abstract social concepts (e.g., social connectedness, love, power) which has provided a basis for much of the research that takes an embodied cognition approach (e.g., Lakoff & Johnson, 1980; Landau, 2016). Researchers have reasoned that metaphors are fundamental to our understanding of the world allowing individuals to understand abstract concepts in terms of simpler ones (e.g., physical experiences; Lakoff & Johnson, 1980). For example, the mental representation of “love”, which has no direct sensory features (e.g., touch, taste), developed via our perceptual experience of warmth (i.e., Kang et al., 2011), and sweetness. This is consistent with findings across several studies that experiencing a sweet taste (i.e., via food or drink) increases positive evaluations of a potential romantic target (Ding et al., 2016; Miska et al., 2018; Ren et al., 2015). Alternatively, experiencing a bitter taste can lead to an increase in negative evaluations, hostility, and aggression (Ren et al., 2015; Sagioglou & Greitemeyer, 2014). An understanding of the abstract concept of love is thereby linked to perceptual sweetness, demonstrating a conceptual-perceptual link.

According to conceptual metaphor theory, a conceptual metaphor involves the partial mapping between abstract concepts (the target domain) and sensorimotor experience (the source domain) to allow reasoning about the target domain (e.g., affection) in terms of the knowledge and language associated with the source domain (e.g., experience of physical warmth) to create insight and greater understanding of the abstract concept (Kövecses, 2005). Therefore, Lakoff and Johnson (1980) reasoned that metaphors are fundamental to our

understanding of the world and allow individuals to understand abstract concepts in terms of simpler ones (e.g., physical experiences; 1980).

Criticism of Conceptual Metaphor Theory

While conceptual metaphor theory is currently the dominant perspective on metaphor it still remains to be widely criticised (Gibbs, 2014). However, both Gibbs (2014) and Kövecses (2017) emphatically claim that most of the critics have based their arguments purely on the original formulation (Lakoff & Johnson, 1980), and have ignored the large amount of research that has been conducted since the book's publication. For example, critics (e.g., McGlone, 2007) argue that linguistic evidence alone is not sufficient "to argue for deep connections between thought and language," (McGlone, 2007, p. 114) and that non-linguistic evidence is required to demonstrate that metaphor is actually a part of cognitive processes (i.e., the way we think) and not just language (i.e., the way we talk; Gibbs, 2014). This argument can be easily dismissed as there is a considerable volume of embodied cognition research demonstrating that metaphor consistent incidental sensorimotor experience (i.e., non-linguistic) can influence our thoughts and behaviour (e.g., Lee & Schwarz, 2012).

A range of non-linguistic based experimental studies have examined the influence of the metaphorical association between valence (good and bad) and verticality (up and down), using a wide variety of methods (e.g., Giessner & Schubert, 2007; Meier & Robinson, 2004). Linguistic evidence for this metaphoric association is shown by the commonality of terms such as feeling up, feeling down, thumbs up, thumbs down, heaven above, hell below (Gibbs, 2014). Non-linguistic comes from research on behaviours or responses that demonstrate congruency between metaphorically related concepts. For example, Meier and Robinson (2004) presented participants with a single word on a screen and asked them to evaluate if the word was a positive term (i.e., pretty) or a negative term (i.e., ugly). Consistent with predictions they found that positive words were correctly identified faster if they were presented higher on the screen than a fixation cue presented in the middle of the screen, and

negative words faster when presented lower on the screen, demonstrating a metaphor consistent effect (Meier & Robinson, 2004).

Using a different methodology, but also incidentally engaging the sensorimotor system, Casasanto and Dijkstra (2010) provided further empirical support for this metaphorical association. In their study participants were randomly assigned to move marbles either up to a higher part of a purpose made box or move marbles down to a lower part of the box, and while engaged in this task participants were given a neutral valence prompt (e.g., tell me about a time when you received a different grade for a test than you expected). The findings indicate that participants in the upward movement condition had a greater tendency to recall a positive memory (e.g., winning an award), and those in the downward movement condition more likely to recall a negative memory (e.g., failing an exam; Casasanto & Dijkstra, 2010).

One major criticism of conceptual metaphor theory is that there is an over reliance on the researchers intuition, and that there is tendency for researchers to handpick the metaphors they wish to examine from their own lexicon, rather than conducting any systematic research on how commonly these metaphors are used in daily language, which may lead to confirmation bias (Kövecses, 2017). This concern is beginning to be addressed with the custom design of software that operates under explicit procedures (i.e., follows objective rules rather than subjective intuition) to discern and identify conceptual metaphors within large corpus, allowing future researchers to identify how commonly each metaphor is used in everyday language (Gibbs, 2014). Embodied cognition researchers can also address this concern by conducting conceptual and direct replications of previously demonstrated metaphor consistent effects, rather than selecting novel metaphors.

Universality and Cultural Specificity

Several researchers (e.g., Rakova, 2002) have found it difficult to accept that conceptual metaphor and embodied cognition theories, which claim that knowledge is

acquired naturalistically (i.e., sensorimotor experience), can simultaneously account for universality and cultural specificity. From a personality and social psychology perspective at first glance this argument does not appear concerning as there are many theories that make similar claims (i.e., trait theories of personality, e.g., Cervone & Pervin, 2010). However, given due consideration it does seem odd that one theory can claim to be universal (i.e., show little to no cultural variance) and at the same time claim to be also culturally specific (i.e., show high cultural variance). To resolve this clash of claims it is worth considering how this clash is addressed in theories of emotional expression.

Charles Darwin proposed that since facial anatomy is shared across all humans (naturalistic) and emotional expressions are evolved reflexes (innate) he predicted that they should present the same way across all cultures (Burton et al., 2019). This prediction is broadly considered to be partially supported as the expression of primary emotions (i.e., anger, fear, disgust, joy, and sadness) was found to be universal, but expression of non-primary emotions (i.e., envy, shame) were shown to vary across cultures and genders (due to acculturation), and that they were influenced by socially accepted cultural display rules (Burton et al., 2019). As such, emotional expression can be considered both universal and culturally specific. Conceptual metaphor theory researchers appear to have taken a similar tact by integrating the construct of primary metaphors (Lakoff, 2012). Primary metaphors are defined by having a source domain that involves a simple inherent (not learned) sensory motor experience, that is common across all cultures (Grady, 1997).

Currently there are two main proposals that aim to integrate the claims of universality and cultural specificity made by conceptual metaphor theory researchers (e.g., Kövecses, 2017). Each of these proposals makes the same prediction that primary metaphors are universal, as they are based in naturalistic embodied experiences, common across all cultures (i.e., warmth is affection; Yu et al., 2017). However, each proposal differs in how they account for cultural variation. Kövecses (2018) proposes that metaphors range from universal

primary metaphors to non-universal context-induced ones, and suggests variation is derived from the pressure of context, which can include social, physical, discourse, and cultural aspects. For example, the conceptual metaphor "affection is warmth" has developed naturally from our early experiences of being loved and embraced by our parents, this is considered a universal association, and therefore a universal primary metaphor (Kövecses, 2018). An example from the other end of this range are Japanese metaphors for anger that incorporate the concept of "hara" (literally means belly), which is unique to the Japanese culture (Kövecses, 2005; Matsuki, 1995). While the Japanese language share many anger metaphors with the English language (i.e., "anger is heat", "anger is a pressurised container"), "anger is in the hara" is influenced by social and cultural contexts, and non-universal (Kövecses, 2018). In contrast, Gibbs (2014) proposed a 'self-organised' view arguing that variation to universal primary metaphors is due to evolutionary, cultural, and historical forces, this view accounts for human experience being varied over time rather than being monolithic and immutable.

Each of the models proposed by Gibbs (2014), and Kövecses (2018), have been very well considered and described by their creators, but are yet to adequately empirically tested. In addition, other factors for the cultural variability of non-primary metaphors have been proposed by other researchers, including sedimentation (i.e., where specific expressions have become stabilised in collective memory and cultural norms over time; Torstensson, 2019), and the level of knowledge, or familiarity, one has with the terms used (e.g., sports terms like slamdunk, touchdown; Schwarz & Lee, 2018). In summary, primary metaphors are thought to apply universally, and there is a vast range of factors that may influence cultural variation in non-primary metaphors.

Future Research

The term embodied cognition is used to describe an increasing number of theories (e.g., grounded cognition, situated cognition, perceptual symbols system, non-modular perspective, somatic marker hypothesis, symbol interdependency hypothesis, radical

embodiment) that posit that cognitive processes are influenced, and shaped by interactions between the body, the environment, and behaviour (e.g., Barsalou, 2010; Damasio & Damasio, 1994; Dove, 2016; Glenberg et al., 2013; Louwerse & Jeuniaux, 2010). Though not an entirely accurate classification system, theories can be placed on a continuum from weak embodiment (theories that contend cognition requires some sensorimotor activation) to strong embodiment theories (those that contend cognition cannot occur without sensorimotor activation; Tirado et al., 2018). Broadly speaking, they all share the assumption that thoughts, feelings, and behaviours are grounded in sensory experiences (e.g., Meteyard et al., 2012; Schubert & Semin, 2009). However, embodied cognition is still considered an emerging and yet to be unified framework (Marmeleira & Santos, 2019; Milkowski & Nowakowski, 2019). In order to integrate, refine, and develop these theories future research in this area needs to move away from novel demonstrations of metaphor consistent embodied effects and move towards empirical work that tests the limitations, mechanisms, and boundary conditions, of the processes involved (Barsalou, 2020; Lee & Schwarz, 2012; Meier, Schnall, et al., 2012). Specific ways this may be achieved is through meta-analysis, conceptual replications, and investigating the potential moderating role of individual differences (Barsalou, 2020; Fetterman et al., in press; Meier, Schnall, et al., 2012).

Chapter 3 : Meta-Analysis

Research in the area of embodied cognition has increasingly been incorporated into broader fields such as education (Rappaport et al., 2018), sports performance (Cappuccio, 2019), robotics (Morgan, 2018), marketing (Krishna & Schwarz, 2014), exercise (Francis & Beemer, 2019; Osypiuk et al., 2018), and mental health (Gjelsvik et al., 2018; Scorolli, 2019). However, the recent replication crisis has raised questions about the validity of the embodied cognition theories, and the methods used in embodied cognition research (e.g., Stroebe, 2019). Systematic review and meta-analysis offer an opportunity to address some of the weaknesses of a seemingly incoherent estimation of the strength of these effects, and the potential to identify publication bias.

Embodied Cognition

Embodied cognition is premised on the idea that "knowledge is not acquired in a vacuum. Instead, all cognitive experiences are necessarily grounded in the sensory and motor contexts of their occurrence " (Goldinger et al., 2016, p.962). Therefore, sensorimotor experiences can shape, influence, and determine cognitive processes such as decision making, judgments, and behaviour (Zestcott et al., 2017). Rather than being considered a peripheral system, the body and its actions, are believed to be central to cognition (Wilson, 2002). As people interact with the world through their senses, sensorimotor experiences play a key role in developing knowledge even in domains that seem abstract (Schwarz & Lee, 2018). For example, associations between early sensorimotor experience (e.g., feeling warmth and comfort with caregivers) scaffold onto later understanding of abstract concepts (e.g., security; Williams & Bargh, 2008).

In line with theories of embodied cognition, conceptual metaphor theory (Lakoff & Johnson, 1999) suggests that metaphors are fundamental to how people understand abstract concepts. Metaphors in everyday language demonstrate that people use concrete experience (e.g., bitterness vs sweetness) to help form their understanding of abstract or complex

constructs (e.g., hostility and attraction; Thibodeau et al., 2019). According to embodied cognition theories these concrete experiences are stored as sensory motor experiences, and therefore manipulating the sensation associated with the concrete concept should lead to effects in the abstract. A considerable portion of empirical research in embodied cognition utilises conceptual metaphor theory to demonstrate metaphor consistent effects by priming the abstract construct via concrete experience (Schwarz & Lee, 2018). For example, participants were more likely to reduce their cooperation in social trust games when exposed to a fishy smell, than a fart or control smell, as this specific smell elicits concerns about the other players' motives. Suspicion is aroused when "something smells fishy", but not by the fart smell which is as offensive, but not metaphor consistent (Lee & Schwarz, 2012). Similar research has shown that tasting a bitter drink (physical disgust) can elicit feelings of moral disgust (Eskine et al., 2011; Schnall et al., 2008) and hostility (Sagioglou & Greitemeyer, 2014). In contrast, tasting a sweet drink can influence perceptions of attraction (Ren et al., 2015) and prosocial behaviour (Meier, Moeller, et al., 2012).

The Current Context

Over the past two decades there have been over two thousand empirical studies on conceptual metaphor, with more than a quarter of these directly related to embodied cognition research (Landau, 2016). Though there has been such a large number of studies published in this domain the reliability, and even the existence, of metaphor consistent embodied cognition findings have been questioned under the current replication crisis (for review see; Earp & Trafimow, 2015; Maxwell et al., 2015) that is affecting the field of social psychology in general (Borghi & Fini, 2019). The replication crisis reflects the contemporary acknowledgment of weaknesses and questionable research practices in psychology that has resulted in the publication of findings that may have little replicability due to poor validity (Shrout & Rodgers, 2018). This has led to a considerable reduction in confidence in established empirical results (Earp & Trafimow, 2015). Research in embodied cognition has

been particularly highlighted during this crisis as several key influential papers have failed to replicate under pre-registered large-scale attempts. A relevant example is a study by Bargh et al., (1996) in which participants that were primed with elderly stereotypes were found to walk slower when leaving the experiment than participants in a control condition, demonstrating the effects of social priming. Several research groups were unable to obtain similar results using the same procedures on different participants (i.e., Doyen et al., 2012) sparking broad debate on the reliability of the original findings, and the effects of priming in general (Harris et al., 2013). This debate has also focused on the findings from embodied cognition research (Ferguson, 2015), with some authors suggesting that "silly published claims on topics such as …embodied cognition" (p.1010), have tricked other researchers into believing false conclusions within their own studies (Gelman & Geurts, 2017). Despite these criticisms, there has been little effort to address these issues whether by replications or by way of systematic review. Similarly, there has been very little attempt to statistically synthesise or consider findings.

An overview of embodied cognition research reveals that it is typically conducted face-to-face, with relatively small samples (e.g., <50 per condition) and, as a result, generally has low power. Meta-analysis is a suitable approach given the issue of low power as it enables integration and summary of the results via statistical processes (Liberati et al., 2009). Metaphorically speaking, a meta-analysis uses the building blocks (Schmidt, 1992), or bricks, of individual empirical studies to build a foundation for the theory, by using a systematic and organised (i.e., PRISMA) approach to summarise the results of multiple studies (Shercliffe et al., 2009). This process averages out distortions and measurement errors to provide a more stable estimate of the reliability of the effects under investigation.

Meta-Analyses of Embodied Cognition Effects

While not intending to directly investigate metaphor consistent embodied effects, Landy and Goodwin (2015) conducted a meta-analysis examining the effects of priming

incidental disgust on moral judgments. They found a minimal effect overall (d = 0.11, k = 50) however a larger effect (d = 0.37, k = 8) when participants were primed with gustatory stimuli, such as a bitter drink (Eskine et al., 2011) or a bad smell (Schnall et al., 2008), than when using non gustatory stimuli, $Q(3,69) = 8.18$, p = .04 (visual; d = 0.13, k = 35, imagined; d = .04, k = 17, other; d = .01, k = 13). Though the researchers made no mention of conceptual metaphor, or embodied cognition, this finding can be taken as support for these theories.

One meta-analysis specifically in embodied cognition for 25 metaphor-consistent embodied effects of a physical weight prime on perceptions of importance (Rabelo et al., 2015). Overall, a moderate to large effect (d = 0.57, k = 25) was found in the predicted direction. However, they suggest that after accounting for what they consider publication bias, the overall effect is actually minimal and in the opposite direction (bias corrected statistics not provided; Rabelo et al., 2015). While they concede that a more thorough investigation is beyond the scope of their article, there are concerns with the approach to their analysis. Firstly, they appear to have included main effects of previous findings regardless of whether the original researchers had planned and predicted an interaction with additional variables. For example, Chandler et al., (study 2; 2012) predicted that the impact of weight cues (i.e., a book) on perceptions of importance are contingent on the subjects knowledge of the item (i.e., J.D. Salinger's Catcher in the Rye), and found that those participants who had read the book before were influenced by its weight. Such that those who held the heavy copy considered it to be more influential than those who held the light-weight copy. This effect was not found for participants who had not read the book. In the Rabelo et al., (2015) meta-analysis they included the data from all participants including those who had not read the book despite this being an expected minimiser of effect strength. Secondly, Rabelo et al., (2015) only used two tests of publication bias to reach their accusation that previous findings in this area (weight-importance) were obtained via questionable research practices. But current research suggests

that a wider range of tests are required to ‘triangulate’ findings in order to reach a more balanced conclusion (van Aert et al., 2019).

While the current meta-analysis will focus on the integration of previous findings it will also use multiple methods to examine the potential presence of publication bias. Publication bias occurs when statistically significant findings are more likely to be published than non-significant findings, which can lead to a loss of perceived credibility of the reported findings (van Aert et al., 2019). This can generally come about through journal editors preferring more ‘interesting’ results (manuscript rejected; Światkowski & Dompnier, 2017), or researchers suppressing results that disconfirm their hypotheses (manuscript not submitted; Ferguson, 2015), which then implies more positive findings than there actually are (Ferguson, 2007). The impact on this bias through the censorship of non-significant findings is further exacerbated when journals require articles to include multiple studies (Schimmack, 2012). According to Schimmack, the sample sizes required to provide sufficient power across a multi-study paper (with each showing statistically significant results) is beyond the resources of all but a few researchers and increases the pressure to use questionable research practices.

Taken together, the consistently low powered studies on conceptual metaphor embodied effects, along with failures to replicate, and the high potential for the presence of publication bias, highlight the need for deeper syntheses of the previously obtained findings, via systematic reviews and meta-analyses. This review was conducted and reported consistent with the latest Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement (Moher et al., 2009).

The Current Study

The empirical studies of this thesis will be based on a previously established metaphor consistent embodied effect. Specifically, the findings that incidental exposure to a fishy smell will undermine cooperation and increase cognitive activity via the inducement of suspicion (i.e., "something smells fishy"; Lee et al., 2015; Lee & Schwarz, 2012). As such, this meta-

analysis will focus on metaphor consistent embodied effects from the gustatory senses (i.e., smell and teste). Additionally, the original study by Lee and Schwarz (2012) included both a control condition (water), and a comparator condition (fart spray) which was considered similarly offensive to the fishy smell, but was not consistent with the 'smells fishy' metaphor.

The current study will also give due consideration to the researcher's predictions during data collection. For example, Hellmann et al., (2013) based their study on the metaphor 'revenge is sweet', and proposed that after having a sweet drink participants would read about and then rate a harmful act more favourably, than those that had been given water (control), but only if it was an act of retaliation rather than unprovoked. Their results supported their hypotheses. In this situation only the participants in the retaliation condition will be included in the analysis.

There are five key aims of this meta-analysis. Firstly, to assess the consistency of these effects to gain an indication of their variability and stability. Secondly, to provide an indication of the potential strength of these findings, in particular metaphor consistent embodied effects that are primed via the gustatory senses. The first two aims will help to determine if it is appropriate to investigate these effects at a deeper level (i.e., boundaries and limitations) or continue to establish base level effects (i.e., direct replications). Thirdly, to assess the general quality level of the identified studies. Fourthly, to compare the strength of the effects when the priming condition is compared to a control, or a comparator. The meta-analysis will analyse separately effects of the target manipulation relative to (a) an active (i.e., water) or passive (i.e., nil) control condition, and (b) a comparator condition (i.e., a spicy taste vs. a sweet taste; Gilead et al., 2015). And finally, to provide a comprehensive assessment of the potential for publication bias.

Method

Search Strategy

Experimental studies testing metaphor consistent embodied cognition effects from physically priming via the gustatory senses were identified by systematic searches of the scientific databases Web of Science, Scopus, Medline, and PsychInfo for academic articles (14th December 2018). Searches of topic, title, abstract, and key words, used terms representing embodied cognition (e.g., ("embodied cognition" OR "grounded cognition" OR "situated cognition" OR "extended cognition" OR "perceptual symbol*" OR "perceptual simulation*" OR embod* OR "somatic marker" OR "social cognition" OR "embodied representation" OR "grounded cognition") AND ("conceptual metaphor" OR "figurative language" OR metaphor* OR idiom* OR simile* OR analogy OR scaffold* OR schema* OR "affective association*" OR "cognitive association*" OR "social surrogate*" OR "repeated association*" OR linguistic OR "preverbal" OR "abstract concept*")) and gustatory sense (e.g., (tast* OR smell* OR scent* OR sweet* OR spicy OR spiciness bitter* OR aroma* OR odor* OR odour* OR gustat* OR olfact* OR sour OR sourness OR salt*)). Further studies were identified by a secondary search for articles that had either cited a key paper on conceptual metaphor theory by Landau et al., (2010) and also appeared in the search results for two of the previously stated search string components (embodied cognition and gustatory)., or had cited a key paper on embodied cognition by Niedenthal and Barsalou (2005) and also appeared in the search results for two of the previously stated search string components (conceptual metaphor and gustatory). Calls for papers were made (i.e., Society for Personality and Social Psychology [SPSP] listserv), however, no additional data were identified.

Inclusion Criteria

Quantitative experimental human studies that used terms related to embodied cognition were included if they: (a) included a physical gustatory prime as the experimental

condition of interest, (b) included a metaphor consistent outcome measure, (c) compared the effect of the metaphor-consistent manipulation to either (i) a metaphor inconsistent manipulation (from here on referred to as a comparator) or (ii) an empty or irrelevant control condition and (d) were published in English and in a peer-reviewed journal.

Study Selection

I used Rayyan, a systematic reviews web app, for exploring and filtering searches for the initial set articles (Elmagarid et al., 2014). Outputs from the primary database searches and the secondary search were combined and duplicates were removed. Screening of abstracts and titles was conducted to identify studies that met inclusion criteria. Full test screening was then conducted to confirm eligibility. All included articles were then further screened to determine eligibility for the meta-analyses (i.e., whether sufficient data was provided to calculate effect sizes). Studies were then separated into those that used a comparator, and those that used a control condition for data extraction.

Data Extraction of Study Characteristics

For each of the studies selected the following characteristics were extracted: authors, title, source (i.e., journal), mean and standard deviation age of sample, sex/gender proportions, location of study, type of intervention (taste or smell), physical prime used, control stimuli (for example, water), comparator stimuli (for example, fart smell), outcome construct (e.g., disgust, revenge, hostility), size of the intervention group(s), size of the control group/comparator group, and results of any statistical analysis that would permit calculation of an effect size. More specifically, means, standard deviations, and sample sizes of each experimental condition were recorded for entry into various analysis software. Data was the entered into separate excel sheets; one for control group analysis and one for comparator group analysis. As such, data was not adjusted when an experiment used both a control and comparator. I also recorded stated statistics related to effect sizes, however these were not used for further analysis.

Quality Assessment of Individual Studies

No existing tool to measure the methodological quality of individual studies included in this review was deemed appropriate. Therefore, a measure was developed consisting of seven criteria that were considered relevant to quality and risk bias: (1) whether an a priori power analysis was reported; (2) whether the experimenters were blind to the condition; (3) whether participants were randomly assigned to conditions; (4) whether an effect size was provided (or stated sufficient statistics were provided to calculate this); (5) whether a probe or check for awareness of the study's purpose was used. The sixth criterion was if there were more than 30 participants in each condition. All criteria were scored as 1 = *yes*, or 0 = *no*. The final/seventh criterion I scored if sufficient demographic information was provided (0.5 for age, 0.5 for gender). A quality score was tabulated for each study out of a possible seven.

Data Synthesis

Studies included in this review were divided into two groups based on whether a control condition or comparator condition was used. The control condition group included studies that used either an active control (i.e., water as a taste stimuli; Ren et al., 2015) or a passive control (i.e., nil or no stimuli; Meier, Moeller, et al., 2012). The comparator group included studies that compared behaviour on the target metaphor consistent smell/taste to a condition in which a metaphor inconsistent smell/taste was presented. When a study included both a control and a comparator condition results were entered into separate meta-analyses to maintain independence. This review was focused on metaphor consistent outcomes, and therefore was not particularly concerned with the actual specific outcome measures used. As such outcomes were not coded based on the measure used, but the broader construct investigated. Apart from two studies, from a single paper, that used binary outcomes (i.e., odds ratio; χ^2), all studies used a continuous outcome variable. The effect size in the continuous outcome studies were reported as Cohen's *d* (k = 6, *t*-tests) or partial η^2 (k = 8, *F*-

tests), or not specifically provided (*k* = 3). Effect sizes were coded such that positive effect sizes always indicated embodied effects in the predicted direction.

Data Analysis

Effect Size. Hedges *g* was calculated for all studies based on the means, standard deviations, and sample sizes for the continuous outcomes, and ratios for the binary outcome studies. In one case the means and standard deviations were not specifically provided but were estimated from their figure (Meier, Moeller, et al., 2012) using a web digitiser.

Heterogeneity Analyses. A random effects model was used for all analyses, as it allows greater generalisation (Borenstein et al., 2013). Cumming (2014) also argues that a random effects model is preferred, and will give results similar to a fixed effects model when results are homogenous, as is expected here. To assess heterogeneity, the Q-statistic, I^2, T^2, and Tau were used. The Q-statistic was included as this is common practice, though it not a measure of heterogeneity in itself, it is used for the calculation of other indicators (Hak et al., 2016). The I^2 is expressed as a percentage (between 0 and 100), where higher scores indicate higher heterogeneity, which relates to the total variability between studies (Cumming, 2014). The T^2 and Tau are measures of the dispersion of true effect sizes between studies (Hak et al., 2016).

Publication Bias. There are many different tests for publication bias that are intended to identify systematic distortions in the provided evidence (Renkewitz & Keiner, 2019). However, there is no definitive test for estimating this bias (Ferguson, 2007). Rather a range of tests are suggested based on the expectations of the data. This 'triangulation process' can provide more balanced conclusions (van Aert et al., 2019). Based on the recommendations of Renkewiz and Keiner (2018) the funnel plot was used to assess symmetry using Begg's rank correlation (measures correlation between effect size and variance; Begg & Mazuumdar, 1994), Egger's regression (weighted regression of effect sizes against standard errors; Egger et al., 1997), and trim-and-fill (estimates number of excluded studies and indicates bias when

number exceeds threshold; Duval & Tweedie, 2000). Second, the distribution of found p-values was analysed using the *p*-uniform test (tests if distribution of p-values match effect estimates; Renkewitz & Keiner, 2019), and finally, Orwin's fail safe *N* will be used to infer the number of additional non-significant findings required to bring the overall effect size down to trivial levels (Orwin, 1983).

Additional Tests. Further to the tests of publication bias, *p*-curve analyses were conducted on both the control group, and comparator group results. The *p*-curve does not provide a formalised indicator of publication bias, but can provide indicators of evidential value by comparing observed effects of significant *p*-values with the distribution implied by a trues effect (Renkewitz & Keiner, 2019). If there is a true effect then the observed distribution will be right skewed (more values between .00 and .01, than between .04 and .05), and if there is no true effect then the distribution will be normal indicating a lack of evidential value (Lakens, 2014). Alternatively, if the distribution is left skewed than this is an indication of *p*-hacking, "the results are not observed by chance, but that researchers actively selected one of the possible tests they could perform on the data (e.g., by excluding participants, selectively reporting variables, etc.) because this test yielded a significant result." (Lakens, 2014, p.5).

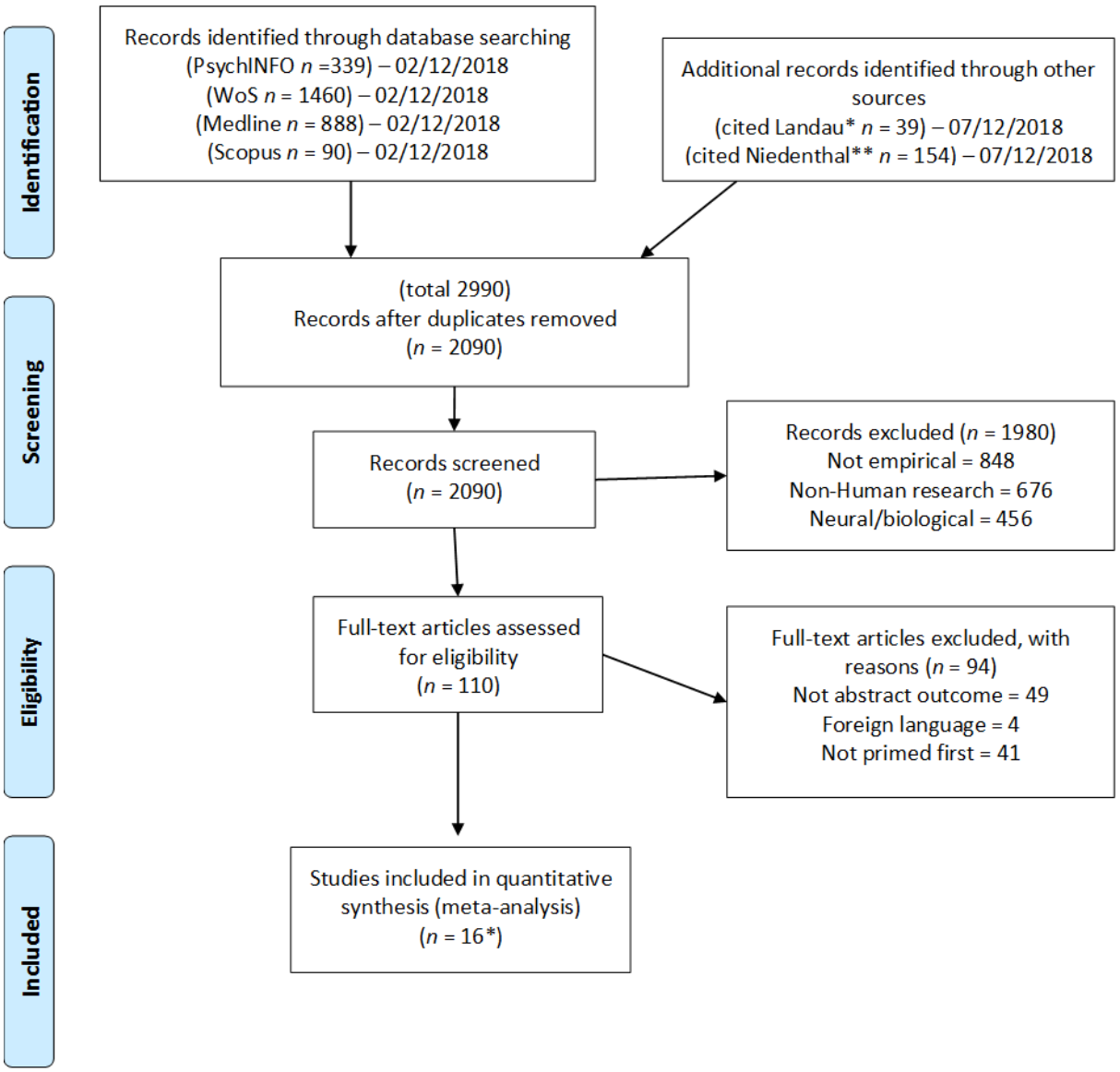
Meta-analyses were conducted using the software Comprehensive Meta-Analysis version 2 (CMA; Borenstein et al., 2013), and the Meta-Essentials excel tools for meta-analysis (Suurmond et al., 2017). I also used the *p*-uniform web application (https://rvanaert.shinyapps.io/p-uniform) and the *p*-curve web application (http://www.p-curve.com/app4).

Results

The results of the search are presented in the PRISMA diagram (Figure 3.1). A total of 19 studies were included from the 16 papers which met full inclusion criteria.

Figure 3.1

A PRISMA Flowchart of Study Selection



Study Characteristics

The characteristics of the 19 studies are presented in Table 3.1. The 19 studies included a total of 1334 participants (mean proportion female = 51.28%, mean age = 21.29, *SD* = 3.04) and sample size ranged from 28-164 (*M* = 70.210, *SD* = 33.778). The vast majority of studies were conducted in North America, although there was also one study from each of the countries China (Ding et al., 2016), Germany (Hellmann et al., 2013), and Israel (Gilead et al., 2015). All participants were university students. There were five studies that

used a smell condition to prime the metaphor consistent effect with the majority (k = 4) using a fishy smell, derived from a fish oil capsule. The remaining studies (k =14) used a taste condition, with most using a sweet taste, via a candy or beverage. Water was generally used in both smell and taste studies as the control stimuli, with two studies using no substance (nil) as the control.

Table 3.1

Characteristics of Studies Included in the Meta-Analyses

	% Fem	Age	Prime	Control	Comparator	Outcome construct	n_e	n_{con}	n_{comp}	g_1	g_2	Quality
Lee et al., (2015), study 1	54.28	np	fishy smell	water		suspicion	31	30		0.70		5.50
Lee et al., (2015), study 2	56.38	np	fishy smell	water		suspicion	44	47		0.47		5.50
Ding et al., (2016), study 3	57.50	20.47	sweet taste		bitter taste	trust	20		20		1.26	4.00
Eskine et al., (2011)	71.93	np	bitter taste	water	sweet taste	disgust	15	21	18	1.12		4.50
Gilead et al., (2015)	50.00	24.75	spicy taste		sweet taste	competence	32		30		0.71	6.00
Hellman et al., (2013), study 1	18.33	25.22	sweet taste	water		revenge	14	14		0.79		3.00
Hellman et al., (2013), study 2	73.49	23.05	sweet taste		mint taste	revenge	20		20		0.61	3.00
Meier et al., (2012), study 4	55.17	19.26	sweet taste		sour taste	prosocial	28		30		0.60	4.00
Meier et al., (2012), study 5	54.54	20.12	sweet taste	nil	bland taste	prosocial	19	17	19		0.58	4.00
Ren et al., (2015), study 1	56.77	19.13	sweet taste		salty taste	romance	41		40		0.80	5.00
Ren et al., (2015), study 2	45.60	19.13	sweet taste	water		romance	37	35		0.54		5.00
Ren et al., (2015), study 3	39.44	19.76	sweet taste	water		romance	71	71		0.29		5.00
Lee & Schwarz (2012), study 1	48.90	20.10	fishy smell	water	fart smell	suspicion	18	14	15	0.81	0.76	6.00
Lee & Schwarz (2012), study 2	29.20	20.50	fishy smell	water	fart smell	suspicion	28	28	26	0.92	0.54	5.00
Saglioglou & Greitmeyer (2014), study 1	65.33	21.27	bitter taste		sweet taste	hostility	38		37		1.14	4.00
Saglioglou & Greitmeyer (2014), study 2	47.72	27.91	bitter taste	water		hostility	23	21		0.69		4.00
Saglioglou & Greitmeyer (2014), study 3	56.10	23.60	bitter taste	water		hostility	82	82		0.55		4.00
Schnall et al., (2008), study 1	57.70	np	fart smell	nil	_	disgust	40	40		0.75		4.50
Troisi & Gabriel (2011), study 1	54.95	19.29	comfort food	nil		relationships	31	27		0.56		6.00

Notes: % Fem, percentage of sample that was female; Age, mean age; Prime, stimuli used; n_e, prime condition size; n_{con}, control condition size; n_{comp}, comparator condition size; g_1, Hedge's g for control; g_2, Hedge's g for comparator, np = not provided.

Quality Assessment of Individual Studies

The majority (k = 9) of the studies scored five or above, and the average score was above the scale mid-point (M = 4.63), with only two studies scoring less than 3.50. There was not a great deal of variability in scores between studies (SD = 0.93). Common strengths of the studies included the use of random allocation to groups, and reporting of effect sizes, and inclusion of demographic information. Only two studies mentioned *a priori* power analysis. Overall scores are included in Table 3.1 (the full breakdown of scores is attached in Appendix A). Quality scoring data was not used in any further analysis.

Results of Individual Studies

Individual effect estimates and confidence intervals for each study that used a control condition are presented Figure 3.2, and those that used a comparator condition in Figure 3.3. Individual effect sizes ranged from 0.29 to 1.26. For studies using a control condition, only one study reported a CI lower limit below zero (-0.04; Study 2; Ren et al., 2015), with all studies showing an effect in the expected direction. Similarly, all studies that used a comparator condition showed an effect in the expected direction, with two studies reporting CI's below zero.

Figure 3.2

Forest Plot for Control Group Analysis

#	Study name	Hedge's g	CI LL	CI UL	Weight
1	Lee & Schwarz (2012), study 1	0.81	0.07	1.59	3.33%
2	Lee & Schwarz (2012), study 2	0.91	0.36	1.48	5.97%
3	Schnall et al., (2008), study 1	0.75	0.30	1.21	8.72%
4	Eskine et al., (2011)	1.12	0.42	1.86	3.62%
5	Saglioglou & Greitmeyer (2014), study 2	0.69	0.08	1.32	4.92%
6	Saglioglou & Greitmeyer (2014), study 3	0.55	0.24	0.87	18.27%
7	Troisi & Gabriel (2011), study 1	0.56	0.04	1.10	6.54%
8	Ren et al., (2015), study 1	0.54	0.07	1.02	8.12%
9	Ren et al., (2015), study 2	0.29	-0.04	0.62	16.28%
10	Hellman et al., (2013), study 2	0.79	0.03	1.60	3.14%
11	Lee et al., (2015), study 1	0.70	0.19	1.23	6.75%
12	Lee et al., (2015), study 2	0.47	0.06	0.90	10.30%
13	Meier et al., (2012), study 5	0.74	0.07	1.44	4.02%

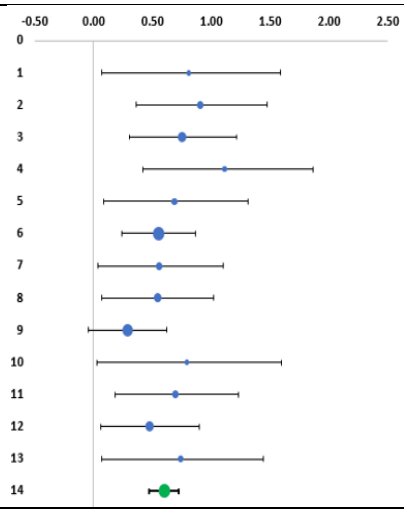
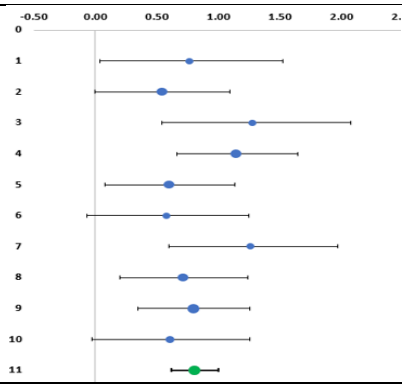


Figure 3.3

Forest Plot for Comparator Group Analysis

#	Study name	Hedge's g	CI LL	CI UL	Weight
1	Lee & Schwarz (2012), study 1	0.76	0.04	1.53	6.28%
2	Lee & Schwarz (2012), study 2	0.54	0.00	1.10	11.08%
3	Eskine et al., (2011)	1.28	0.54	2.07	5.87%
4	Saglioglou & Greitmeyer (2014), study 1	1.14	0.66	1.64	13.59%
5	Meier et al., (2012), study 4	0.60	0.08	1.14	11.78%
6	Meier et al., (2012), study 5	0.58	-0.07	1.25	7.87%
7	Ding et al., (2016), study 3	1.26	0.60	1.97	7.14%
8	Gilead et al., (2015)	0.71	0.20	1.24	12.35%
9	Ren et al., (2015), study 1	0.80	0.35	1.26	15.81%
10	Hellman et al., (2013), study 2	0.61	-0.02	1.26	8.23%



Syntheses of Results

Effect Sizes. The overall effect size for studies using a control condition was Hedge's g = 0.60 (SE = 0.06), 95% CI [0.47, 0.73], Z = 10.386, p < .001, indicating that there was a significant difference between the experimental and control effects in the expected direction. Similarly, studies using a comparator condition also yielded a Hedge's g = 0.81 (SE = 0.08), 95% CI [0.62, 1.00], Z = 9.54, p < .001, indicating that there was a significant difference between the experimental and comparator effects in the expected direction. Though Hedge's g is not an indicator of statistical significance between groups, this can be implied from all individual effect sizes being positive (Hak et al., 2016).

Heterogeneity Analyses. To assess heterogeneity the Q-statistic, I^2, T^2, and Tau were calculated. All key indicators (I^2, T^2, and Tau) were calculated as zero, indicating that there was minimal heterogeneity across the studies, or little dispersion of true effect sizes. This was the same for both the control and comparator analyses.

Publication Bias. Funnel plot for studies using a control condition are presented in Figure 3.4 below. Visual inspection of the plot suggests potential issues with asymmetry which is supported by both Begg's rank correlation (p = 0.010), and Egger's regression (p = 0.003) which were significant indicating the potential presence of publication bias. However, the trim and fill procedure (Duval & Tweedie, 2000) did not indicate that additional/imputed values were required, suggesting an equal distribution of effect sizes on both sides of the

mean effect size, indicating symmetry and lack of publication bias in the control group analysis. Similarly, *p*-uniform test (Irwin-Hall distribution) was not significant ($p = 0.369$) indicating no evidence of publication bias and the Orwin's fail-safe *N* (with a conservative criterion of 0.15) equalled 117 studies indicating findings are robust using the criteria of fail-safe $N > 75$ in this case (Rosenberg, 2005).

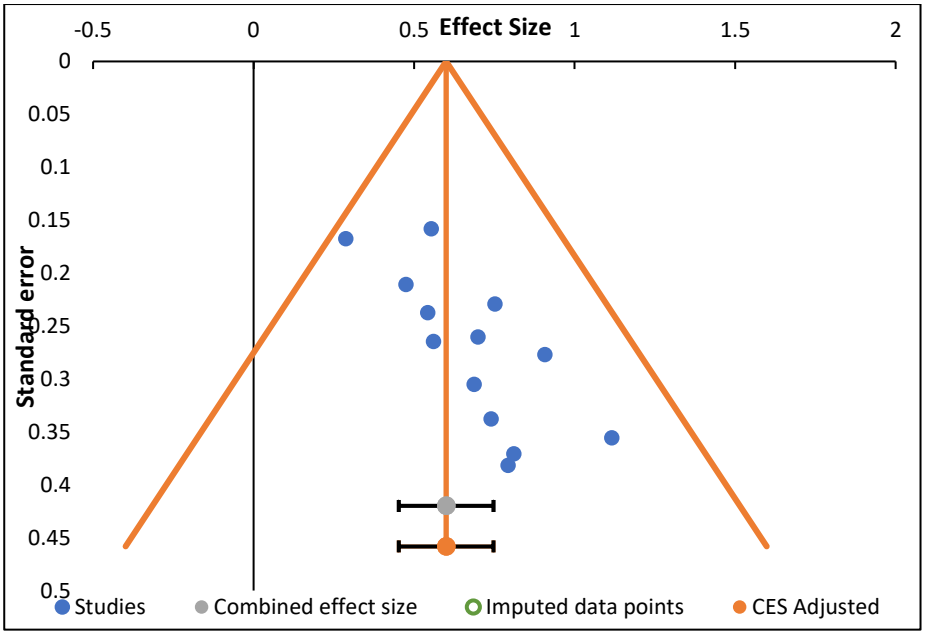
Table 3.2

Indicators of Publication Bias (Yes = Presence of Bias)

	Funnel plot asymmetry			*p*-uniform test	Orwin's fail safe *N*
	Begg's rank correlation	Egger's regression	Trim and fill		
Control Group	Yes	Yes	No	No	No
Comparator group	No	No	Yes	No	No

Figure 3.4

Funnel Plot for Control Group Analysis

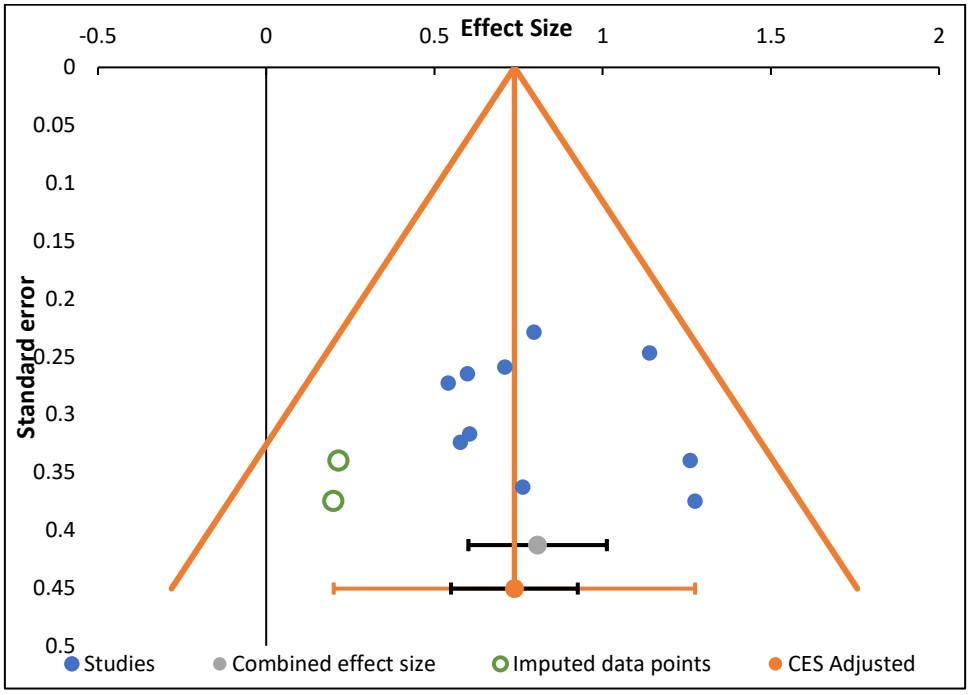


For the studies using a comparator condition analysis neither Begg's rank correlation ($p > .05$), and Egger's regression ($p > .05$) indicating no presence of publication bias. The

Duval and Tweedie trim and fill procedure indicated that two additional/imputed values were required suggesting an unequal distribution of effect sizes on both sides of the mean effect size, the addition of these values resulted in an unbiased adjusted Hedge's *g* of 0.74 (*SE* = 0.09), 95% *CI* (0.55, 0.93; see Figure 3.5). The *p*-uniform test (Irwin-Hall distribution) was not significant ($p = 0.961$) also indicating a lack of publication bias. Finally, Orwin's fail-safe *N* (with a conservative criterion of 0.15) equalled 132 studies. Findings are considered robust if the fail-safe *N* (117) is > 5*k* + 10 (Rosenberg, 2005).

Figure 3.5

Funnel Plot for the Comparator Group Analysis

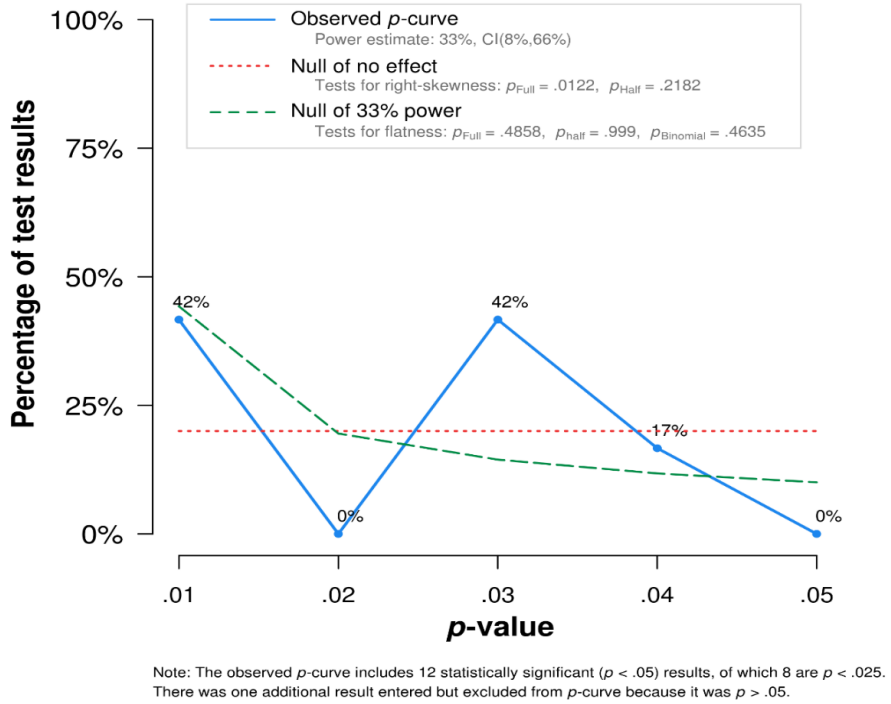


Additional Tests. The *p*-curve analyses were conducted using z-scores from the studies presented in Table 1. For the control group analysis Figure 3.6 shows that 12 studies of 13 were statistically significant. If the half *p*-curve test is right skewed ($p < .05$), or both the half and full test are right skewed ($p < .100$) this indicates the presence of evidential value (Simonsohn et al., 2015). Evidential value indicates that the set of significant findings in the analysis are unlikely to be based on selective reporting (Simonsohn et al., 2014). Here, while the full *p*-curve was significantly right-skewed ($p = .012$) indicating evidential value, the half

p-curve was not (p = .218), indicating a lack of evidential value. The *p*-curve analysis also indicates if evidential value is inadequate if the 33% power test is $p < .05$ for the full p-curve or both the half *p*-curve and binomial 33% power test are $p < .10$ (Simonsohn et al., 2015). Neither condition was met for the 33% power tests indicating that the evidential value was adequate.

Figure 3.6

Control Group p-curve Analysis

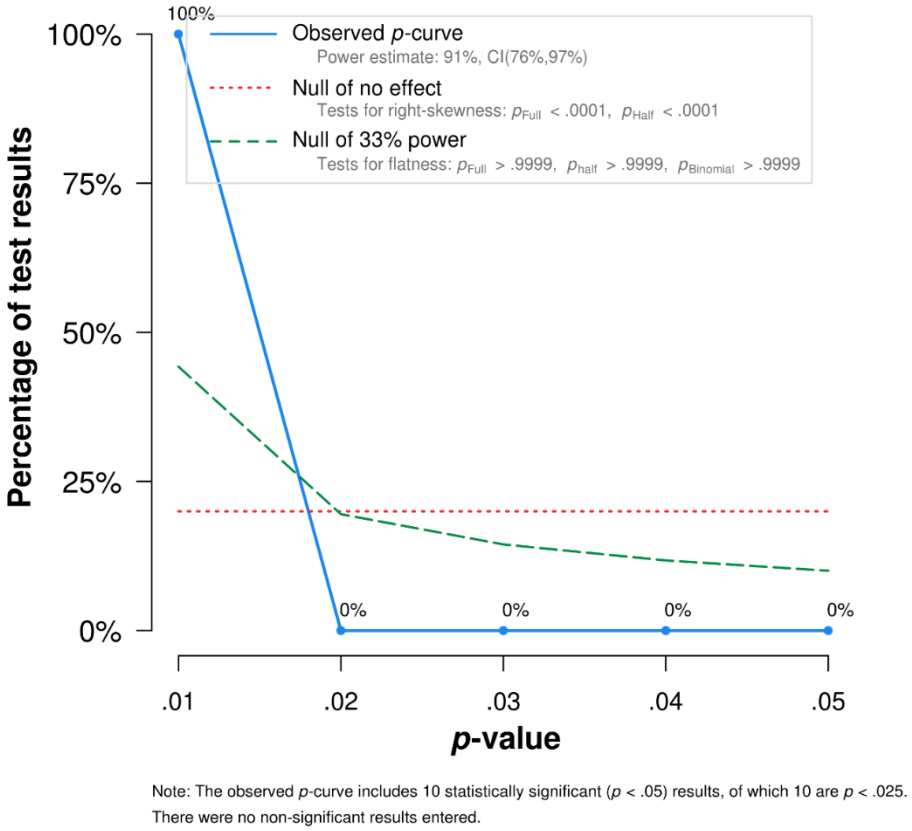


Note: The observed *p*-curve includes 12 statistically significant ($p < .05$) results, of which 8 are $p < .025$. There was one additional result entered but excluded from *p*-curve because it was $p > .05$.

For the studies using a comparator condition analysis Figure 3.7 shows that all 10 of the studies included were statistically significant. Here, both the half *p*-curve ($p < .001$) and the full *p*-curve ($p < .001$) were significant indicating the presence of evidential value. The *p*-curve analysis also indicates if evidential value is inadequate if the 33% power test is $p < .05$ for the full *p*-curve or both the half *p*-curve and binomial 33% power test are $p < .10$. Here neither condition was met, indicating the evidential value was adequate, which supports the findings when only considering skew.

Figure 3.7

Comparator Group p-curve Analysis



Note: The observed *p*-curve includes 10 statistically significant ($p < .05$) results, of which 10 are $p < .025$.
There were no non-significant results entered.

Discussion

The broader aim of this meta-analysis was to inform and direct the design of the empirical studies to be conducted for this thesis. The findings when synthesising the previous literature suggest that metaphor consistent embodied effects primed via the gustatory senses can be considered consistent, stable, and of moderate strength. These effects are present when using a comparator condition or a control condition. The quality of the analysed literature was generally strong, with most studies scoring above the scale midpoint, indicating key criteria of quality research were generally met. A comprehensive range of tests also indicated that the reported results were unlikely to be overly affected by publication bias or be the product of questionable research practices.

Overall, the results of the meta-analyses indicated that priming gustatory sense metaphors can result in moderate to large embodied effects (Ellis, 2010) with little variability

(Hedges & Olkin, 2014), and can be considered stable. These findings suggest that the foundational research on metaphor consistent embodied effects have demonstrated sufficient strength to warrant further investigation and should be considered as relevant to theories of embodied cognition.

In order to better inform future research, separate analyses were conducted for studies with a control condition, and studies with a comparator condition. Both analyses found strong homogeneity with very little heterogeneity across included studies, and good precision. For the control group analysis the overall effect was moderate, and for the comparator group the effect was large, though the difference between them was not considerable. Indicating that using a comparator is similar in terms of effect strength to using a control condition. This would be expected based on previous research that used both comparator and control stimuli, as included studies such as those conducted by Meier et al. (2012), and by Eskine (2011) which used both comparator and control conditions reported no difference between these conditions on their outcome measure. However, conceptually they may demonstrate different effects and strengthen the findings. For example, Lee and Schwarz (2012) used both an active control (water) and a comparator (fart-spray), against their experimental condition (fish-oil) to investigate the embodied metaphor consistent effect of using a fishy smell to prime suspicion. In this case the fart spray demonstrated that their results were not merely the effect of an unpleasant, or offensive smell, but were specifically related to the metaphor ‘something smells fishy’. There was also no difference in suspicion related behaviour (social trust) between the comparator or control conditions (Lee & Schwarz, 2012). This suggests it would be best to use both a control and a comparator where possible in future research.

A critical assessment of the quality of the selected studies indicated that studies were generally conducted and reported well. The lack of *a priori* power analysis in most of the selected studies, or mention of how sample size was calculated, is reflected in the small sizes used, and large within study variance (*CI*s) shown in the forest plots. This is initially

concerning, however, given that this is a relatively new area of research, and the novelty of the studies, it is difficult to estimate *a priori* effect sizes for power calculations. Nearly half of the studies included in the analysis involved sample cells (condition *n*'s) with less than 30 participants ($k = 9$ out of 19). Using 'rules of thumb' these sample sizes are more than adequate for pilot studies (Julious, 2005), and can be considered sufficient for new areas of research, particularly when comparing groups on a continuous outcome measure (i.e., *t*-tests; Van Voorhis & Morgan, 2007). Some may consider consistently obtaining moderate to large effects using small sample sizes in a relatively new area of research an alarm for publication bias and questionable research practices, and as such, the potential for this was comprehensively tested.

For the control group analysis two of the five tests indicated the presence of publication bias as can be observed in the asymmetry of the funnel plot; Begg's rank correlation and Egger's regression. However, given the lack of heterogeneity across studies these results should be interpreted with caution, as these tests are more accurate with higher dispersions (Tang & Liu, 2000). When all studies included in the analysis have significant findings (individually), and the number of included studies is small (as is the case here), the most appropriate test to consider is the *p*-uniform test, as it is particularly accurate in this scenario (van Assen et al., 2014). For the control group analysis both the *p*-uniform test and Orwin's fail safe *N* indicate that the overall effect was robust to publication bias. For the comparator group analysis only one of the tests indicated the presence of publication bias. Though other tests of asymmetry of the funnel plot were acceptable (Begg's and Egger's) the Duval and Tweedie trim-and-fill procedure added two imputed values. The addition of these values creates an unbiased overall effect by accounting for publication bias (Duval & Tweedie, 2000). The new unbiased effect was still moderate to large ($g = 0.74$) indicating the stability of the overall effect. Taken together, the results from the broad range of tests, indicate that the findings can be considered robust to publication bias.

Though not a measure of publication bias, the *p*-curve analyses provide an indication of the evidential value of the synthesised findings (Lakens, 2014; Renkewitz & Keiner, 2019). The results for the control group analysis were conflicting, with the main test finding a 'flat' distribution of *p*-values, which does not indicate evidential value of a true effect. Whereas the reduced power test indicated evidential value was sufficient, and thus a true effect may be present. The lack of a left skew in the distribution of p-values indicates that there was not a concern with *p*-hacking. The *p*-curve tests for the comparator group analysis were both positive, indicating that the synthesised results had evidential value of a true effect. Similar to the control group analysis, there was no indication of *p*-hacking in the comparator group analysis.

The findings from the present study were not consistent with the previous meta-analysis conducted by Rabelo et al., (2015). They focused on the *p*-uniform test to suggest that findings related to the metaphor consistent embodied effect of weight on importance were subject to publication bias and questionable research practices. The results of the same test used in the current study did not indicate any concerns with publication bias in either the comparator group or the control group analyses. The differences may be due to how Rabelo et al., screened the data for inclusion in their analysis, or it may also be that gustatory effects are more consistent, than weight, and possibly this type of priming in other sensory modalities.

Limitations and Future Directions

In order to direct and inform the latter portions of this thesis, this review included only studies related to gustatory priming. However, by including priming of the other primary senses (touch, sight, hearing) and additional sensations (e.g., proprioception), the number of potentially relevant studies would be vastly increased, and provide a much more comprehensive synthesis of the previous empirical findings in the broader embodied cognition domain. This would also allow for the effects to be compared across modalities, and

potentially identify variations that may lead to further understanding of these metaphor consistent embodied effects.

A further limitation of this study was that there were no non-significant findings included in the analyses. However, Orwin's fail safe *N* indicated that a large number of non-significant findings (more than ten times the number included), would be needed to bring the overall effect down to trivial levels. For example, in the control group analysis which included ten studies the addition of 132 non-significant studies would be needed to bring the overall effect to Hedge's *g* of 0.15, which is small but still positive.

Finally, there were a number of potentially relevant studies (i.e., for screening) known to the author ($k = 9$) that were not identified by the primary search. Some of these ($k = 4$) were picked up with the secondary search strategy, but more than half of these were not. A closer examination of these papers showed that two suitable papers (Miska et al., 2018; Yu et al., 2013) were not present in any of the databases on the last day of searching. The remaining studies were present in at least one of the databases used but did not include terms related to embodied cognition or conceptual metaphor theory in their title, keywords, or abstract (i.e., 'The smell of virtue: Clean scents promote reciprocity and charity'; Liljenquist et al., 2010). These papers were not included here, consistent with the requirements of search replicability, however, the impact was considered and the effect of their inclusion was little (and can be reviewed in Appendix A).

Conclusions

Based on the results of this analysis, using the data obtained via a comprehensive search strategy, it can be concluded that there is a consistent moderate effect of metaphor consistent embodied effects via gustatory priming. The meta-analyses reported here combine data across studies in order to estimate effects with more precision than a single study and indicated that gustatory priming was associated with moderate to large effect of metaphor consistent embodied cognition. Moreover, this effect was very homogeneous and there was,

little evidence of publication bias despite different concepts (e.g., suspicion, trust, hostility) and small samples. Now that these initial effects have been shown to be stable and consistent, future researchers may use these findings in *a priori* power analyses, which will enhance the quality of future studies. Though the theories and findings related to the field of embodied cognition of been particularly debated and questioned in the current "replication crisis" (i.e., Stroebe, 2019), the results of this review indicate that it is a field worth further investigation, and should bolster confidence in this domain.

Chapter 4 : Introduction to Empirical Studies

The aim of the meta-analysis was to inform and direct the design of the empirical studies that are to be conducted for this thesis. The findings when synthesising the previous literature suggest that metaphor consistent embodied effects primed via the gustatory senses can be considered consistent, stable, and of moderate strength. This provides support for further investigation of these effects, including both replication, and examination of boundaries and limitations.

The current embodied cognition literature has focused on accumulating evidence of perceptual influence effects across a wide range of perceptions and behaviour, however the limitations of these effects have yet to be investigated. The first empirical study of this thesis will investigate whether personality traits interact with metaphor based embodied effects.

Definitions of personality include terms such as "stable and consistent patterns of behaviour", "relatively enduring", and "biologically based behavioural tendencies" (i.e., Cervone & Pervin, 2010). It would seem unlikely that transient changes in our environment (i.e., the presence of a fishy smell) could influence our behaviour without some sort of interaction with stable personality traits.

The proposed study will also aim to replicate the previously demonstrated metaphor based embodied cognition effects that links a fishy smell to the abstract concept of suspicion (Lee et al., 2015; Lee & Schwarz, 2012). To my knowledge, this will be the first attempt to replicate this specific effect both beyond the original research team and outside the United States of America.

The findings from the meta-analyses also indicated that there would be a benefit in including both a comparator and a control condition in future research. Though the strength of the effects were similar (i.e., for comparator vs. experimental, and control vs. experimental), conceptually they may demonstrate different effects and strengthen the findings. In line with the previous research (i.e., Lee et al., 2015; Lee & Schwarz, 2012), the first empirical study

will use both an active control (water) and a comparator (fart-spray), against the experimental condition (fish-oil) to investigate the embodied metaphor consistent effect of using a fishy smell to prime suspicion. This will demonstrate that results are not merely the effect of an unpleasant, or offensive smell, but is specifically related to the metaphor 'something smells fishy'.

The following power analysis was conducted using the G*Power: Statistical Power Analyses program (Faul et al., 2007). For the calculations, the data from the original Lee and Schwarz (2012) paper were considered. In that study they had a total of 82 participants, fish-spray (N = 28, M = 2.65, SD = 1.27), fart-spray (N = 26, M = 3.38, SD = 1.39) and water (N = 28, M = 3.86, SD = 1.36). The effect size for fish vs. fart was d = 0.92, and for fish vs. water was d = 0.55. This was further calculated to have an overall f^2 = 0.50. Based on the findings from the meta-analysis a moderate to large effect could be reasonably expected which is consistent with using an f^2 of 0.50. Taking into account the potential interaction (continuous trait scale), and using a k of 3, an α of 0.05, desired power of .80 (1- β), G*Power indicated that a sample consisting of 111 participants (3 groups of 37) would obtain an estimated power of 0.804.

Chapter 5 : Study 1

Previous research has demonstrated that the perception of a fishy smell can elicit suspicion (Lee et al., 2015; Lee & Schwarz, 2012). However, there are no independent replications of this effect. While there are many examples of embodied metaphors, few are as well established as that of the fishiness-suspicion effect (Lee et al., 2015; Lee & Schwarz, 2012). In the original study Lee and Schwarz (2012), participants were incidentally exposed to a fish oil (i.e., metaphorically relevant scent), fart spray (i.e., unpleasant but metaphorically irrelevant scent), or water (i.e., control condition) while they were asked to play an economic trust game (Lee & Schwarz, 2012; Study 1) or a public goods game (Lee & Schwarz, 2012; Study 2) with an endowment of $5. They found that participants who completed this task in the fishy odour condition invested less money than those in the other conditions, with no statistical difference between investments found for the fart spray and water conditions. These findings were interpreted as evidence that the fishy odour primed the concept of "fishiness" prompting these participants to be distrustful and causing them to invest less in an action that would only be beneficial if other participants were trustworthy.

In a further demonstration of the link between suspicion and a fishy smell, Lee et al., (2015) utilised the Wason Rule Discovery Task (WRDT:Wason, 1960) to show the arousal of suspicion (via the fishy smell) could enhance critical thinking shown by the avoidance of confirmation bias because these participants would be less likely to take information at face value. Consistent with embodied cognition predictions, participants who completed this task in the fishy smell condition were more likely to generate a negative hypothesis test than those in a control condition. This result was interpreted as evidence that this effect is not limited to social dilemma tasks and may be found across other domains.

The current research was designed to provide an independent replication of the fishiness-suspicion effect (Lee et al., 2015; Lee & Schwarz, 2012), and to extend this research by considering the potential effect of relevant individual differences as a limit or facilitator of

the embodied effect. For example, it seems possible that an individual's chronic propensity for suspicion may interact with a suspicion prime leading to responses that vary in strength. To date, embodied cognition research has failed to consider such potential moderating effects.

In the case of the fishy smell-suspicion link, I reasoned that individual differences could affect the effect in several ways. First, it is possible that those high in trait distrust are especially sensitive to contextual cues that something may be wrong. If so, the effect of embodied cues should be more pronounced as trait distrust increases. Alternatively, embodied cues should affect all perceivers, independent of trait distrust which suggests that such cues may have adaptive values and may, consequently, dominate an individual's predispositions. The present study will elucidate this question and add to the robustness of two of the previously reported effects.

Individual differences in chronic or trait distrust may have both an evolutionary basis and provide a contemporary context for social and interpersonal behaviour (McNamara et al., 2008). Specifically, any social situation provides cues to the trustworthiness of the other people involved that are viewed through a lens that includes a propensity to be trusting or not (e.g., Chugtai & Buckley, 2008). However, this lens serves only to guide or contextualise decisions and behaviour (e.g., Mischel & Shoda, 1995). Taking an integrative approach affords researchers the opportunity to consider the contribution of personal (i.e., trait) and social influences (i.e., context) in predicting real-world outcomes. It is a significant advance on research that has focussed on one or the other, but is less common than is desirable, although fairness dictates that understanding the broader picture is only possible after understanding an effect sufficiently to step back and consider the context.

While the embodied effect of a fishy smell priming suspicion across multiple outcomes has been well demonstrated one shortcoming of this literature is that it has overlooked the context provided by the individual. That is, the person's character or personality provides a basis for relatively consistent behaviour across contexts (Rauthmann et

al., 2016). In particular, a person's propensity to be trusting or suspicious may be an important factor to consider in tandem with the embodied effects of the fishy smell.

The traits or characteristics that are most likely to be directly relevant to the proposed study are dispositional trust and dispositional distrust. Though often thought of as the ends of the same continuum, they can be considered closely related but distinct psychological traits (Reimann et al., 2017; Schul & Peri, 2015). High distrust is characterised by vigilance, fear, and cynicism, whereas low trust is characterised by hesitance, and a lack of confidence, and it has been demonstrated that distrust and trust can occur simultaneously (McKnight et al., 2004). For example, when distrust is high, trust may also be high; suggesting that such individuals "trust but verify" (McKnight et al., 2004).

Dispositional trust has consistently been shown to influence social decision making, such as that used in the public goods game (De Cremer, 1999; De Cremer et al., 2001; Dijkstra, 2013; Parks, 1994). Those high in dispositional trust tend to cooperate in public goods type games as they have positive expectations that others will also contribute fairly (i.e., funds into a communal pool; De Cremer et al., 2001). In a meta-analysis of 60 effect sizes, Balliet and Van Lange (2013) found a small to moderate positive relation between dispositional trust and cooperation across different types of social dilemmas (i.e., public goods, prisoners, and resource dilemmas). Dispositional trust has also been found to be a stronger predictor of contribution than social value orientation (an individual's tendency to behave in a cooperative, competitive, or individualistic manner when allocating resources; Murphy & Ackerman, 2014), emphasising that it is an individual's perceived expectation of others behaviour, rather than a belief in what is the right thing to do, that drives the individual's behaviour (Parks, 1994).

Research has also shown the positive influence of distrust on critical thinking such as that demonstrated by behaviour in the WRDT (Mayo, 2015; Mayo et al., 2013). Researchers suggest that "distrust triggers a spontaneous activation of alternatives and incongruent

associations" (Mayo, 2015, p. 283) which then blocks effects such as confirmation biases, and increases the likelihood of using a negative hypothesis test in the WRDT (Mayo et al., 2013). Although both the Mayo, and the Mayo et al., studies focus on the term distrust, in each case they used the General Trust Scale (GTS; Yamagishi & Yamagishi, 1994) to measure distrust, or lack of trust.

The Current Study

The aims of the current study are firstly to provide an independent conceptual replication of previous findings that have demonstrated the metaphor consistent effect of a fishy smell on social (i.e., public goods game; Lee & Schwarz, 2012) and cognitive decision making (i.e., WRDT; Lee et al., 2015) via the inducement of suspicion. Additional measures, task duration and a face-based trust judgment task, have also been included to further examine and extend the previously demonstrated effects. The second aim is to investigate the potential interaction effects of trait distrust on these findings.

The previously demonstrated effects have been linked to the inducement of suspicion (Lee et al., 2015; Lee & Schwarz, 2012). "State suspicion is a person's simultaneous state of cognitive activity, uncertainty, and perceived malintent about underlying information" (Bobko et al., 2014, p.336). If cognitive activity and uncertainty are aroused by the presence of the fishy smell then it would be expected that participants will take longer to complete tasks.

A measure of face-based trust judgments using Oosterhof and Todorov's (2008) digitally manipulated trust faces has also been included in the current study. In this task, participants view a series of images of faces and are asked to rate them on how trustworthy they appear. Recent research has demonstrated that participants high in dispositional distrust have a higher criterion for what makes a face trustworthy than participants low in distrust (Calabrese et al., 2017). While there is a large volume of research on trait perceptions of the target face, there is very little on the perceivers personality traits or states (Hehman et al., 2019) such as suspicion or distrust. However, as suspicion involves a perception, or

assumption of malintent (Bobko et al., 2014) and distrust involves cynicism and a negative expectations of others (McKnight & Chervany, 2001; Van De Walle & Six, 2014), I reason that both of these (dispositional distrust and induced suspicion) would be negatively associated with the perceptions of others trustworthiness.

Based on the reviewed literature the following predictions were made. Firstly, it is predicted that participants in the fishy condition, relative to the fart spray or control condition, will a) make lower offers in the public goods game, b) be more likely to use a negative hypothesis test in the WRDT, c) take longer to complete the experimental tasks, and d) provide lower ratings of trustworthiness for all faces presented in the facial trust measure. Secondly, it is predicted that trait distrust will be negatively correlated with a) offers in the public goods game, b) use of a negative hypothesis test in the WRDT, c) time taken to complete the experimental tasks, and d) ratings of trustworthiness for all faces presented in the facial trust measure. Finally, it is predicted that there will be an interaction between individual dispositional trust trait scores and the observed effect of fishy smell on suspicion. Specifically, those that score low on the distrust scale, would be more susceptible to the influence of the fishy smell, than those that score high on distrust.

Method

Participants

The sample consisted of 113 participants (women = 69.91%), which included 84 undergraduate psychology students from the Melbourne campus of the Australian Catholic University (ACU) and a sample of convenience (i.e., non-students; n = 29). Student participants received 0.75% course credit for their participation. All participants were over the age of 18 (M = 28.92, SD = 9.79). One participant chose to withdraw from the study prior to completing all measures (fart smell condition).

Materials

A copy of the facial trust stimuli and all measures used in this thesis can be found in the Appendices (Appendix B).

Demographics Questions. Participants' age, gender, education, nationality, native language, and ethnicity were recorded.

General Trust Scale. (GTS; Yamagishi & Yamagishi, 1994). Participants are asked to state their agreement with six statements measuring beliefs about other people's trustworthiness (i.e., "Most people are basically honest" on a 5-point Likert scale from 1 (*strongly disagree*) to 5 (*strongly agree*). Scores were summed providing a total score, with higher scores indicating a higher tendency to trust others. The scale showed good internal reliability in the current study (Cronbach's $\alpha = 0.847$).

Distrust Scale. Distrust was assessed using the ten items from the International Personality Item Pool (IPIP; Goldberg et al., 2006) that has demonstrated good convergent validity with Cattell's 16PF factor of Vigilance ($r = .75$; Conn & Rieke, 1994). Items are descriptive statements (e.g., "I am wary of others") to which participants respond using a 5-point scale ranging from 1 (*very inaccurate [of me]*) to 5 (*very accurate [of me]*). After reverse scoring four items indicative of trustingness, scores were summed, with a high score indicating high dispositional distrust. The scale demonstrated good internal consistency in the current study (Cronbach's $\alpha = 0.803$).

Intellect Scale. Intellect was assessed using thirteen items from the IPIP (Goldberg et al., 2006). Each item consisted of a statement (i.e., "I tend to analyse things") and participants were asked to indicate the extent to which the statement described them on a 5-point scale as a description of the participant from 1 (*very inaccurate*) to 5 (*very accurate*). Five items were reverse scored, and then all scores totalled, with a high score indicating high intellect. Cronbach's $\alpha = 0.763$. This measure was initially included as a potential moderator of

performance in the Wason's Rule Discovery Task (Wason,1960), but was not included in the predictions for this study.

The Alternate Uses Task. (AUT; Wallach & Kogan, 1965). This task presents participants with a common everyday object (i.e., a brick) and asks them to list as many possible uses for the object as they can think of within two minutes. Two researchers independently scored the responses for fluency (total number of ideas), and originality (uniqueness of ideas), any discrepancies were resolved. This task has been commonly used as a measure of creativity (Kaufman et al., 2008), and has also been previously used to demonstrate a relationship between creativity and the use of negative hypothesis testing in the Wason's rule discovery task (Vartanian et al., 2003).

Odour Stimuli. Odour stimuli were infused into a paper towel and placed in a small cardboard box located out of view under the desk in the testing room. For the fishy condition, a single capsule of cod liver oil (Healthy care 1000mg) was used to infuse the paper towel. For the fart smell condition, the paper towel was sprayed with a short spray of joke fart scent (Forum Novelties, NY). In the control condition the paper towel was splashed with normal tap water.

Public Goods Game (modelled after; Berg et al., 1995). Consistent with Lee and Schwarz (2012) the public goods game was used as a measure of social trust. I used a computerised version of the test in which participants were assigned 10 tickets to enter a raffle to win a $250 voucher for a major Australian retail chain. Participants were told that they could "invest" as many of the 10 tickets as they wished into a communal fund. They were told any tickets they and the other participants invested into the fund would be doubled, and then the fund would be split evenly between all members of the group. Instructions were presented on a screen explaining that the participant would be computer matched with three other participants and a drop-down menu appeared for participants to select the number of tickets

they chose to invest. Participants were then informed of the total number of tickets they had accumulated after fund returns.

Wason's Rule Discovery Task (Wason, 1960). This measure compares participant's use of positive hypothesis testing (confirming tests), and negative hypothesis testing (disconfirming tests; Wason, 1960) when trying to identify the rule governing the generation of a numerical sequence. Participants were presented with a set of three numbers (i.e., 2-4-6) and were told that their task was to figure out the rule that generated the series of numbers presented (e.g., "numbers increase by 2"). After they provided their best guess of the rule, they were given three opportunities to test their hypothesis by entering three sets of three test numbers into the computer (e.g., 4-6-8; 8-10-12; 14-16-18). Previous research has shown that most participants (around 80%; Klayman & Ha, 1989) enter only sets that confirm their rule (positive hypothesis test; e.g. 1-2-3, would be confirming test if they hypothesised that the rule is "increasing numbers"), rather than sets that disconfirm their rule (negative hypothesis test; e.g. 1-2-3, would be a disconfirming test if they hypothesised that the rule is "increasing even numbers"). After receiving feedback, indicating whether each of their sets fit the rule, participants were asked whether they wished to change their original guess/rule. Finally, participants were asked whether they had seen this task before.

Facial Trust Measure. The facial trust measure assessed participant's perception of the trustworthiness of unfamiliar computer-generated face stimuli with established levels of trustworthiness (Oosterhof & Todorov, 2008). All facial stimuli selected were Caucasian, male, and bald to reduce possible confounding effects (e.g., status and attractiveness). Two facial identities were selected. Each facial identity had 7 variations of trustworthiness (from -3 to +3 SD away from the original face on the model's trustworthiness dimension). All participants viewed each of the 14 stimuli once and made a judgement of trustworthiness using a visual analogue scale (-30, Very Untrustworthy to +30, Very Trustworthy).

Procedure

Ethics approval was obtained from the Australian Catholic University Human Research Ethics Committee prior to any data collection (2015-76H; certificate attached in Appendix C). Individuals were recruited to participate in a study investigating individual differences and decision making. The first part of the study was conducted online prior to coming into the lab. In the first part of the study, participants were presented with an explanatory statement, and information about the study (attached in Appendix D), before being asked to provide consent (form template attached in Appendix D), and complete the demographic questions, personality measures (GTS, Trust, Distrust, Intellect), and the Alternate Uses Task. They then booked a time, and day, to come into the lab for the second part of the study. Participants were randomly allocated to the fish-oil (n=38), fart spray (n=37), or water (n=38) conditions and taken to the pre-scented room to complete the remaining measures. The presentation order of the Wason task and the public goods game was alternated, but the facial stimuli task was always presented last. Finally, participants completed an exit survey and manipulation check, which were designed to test whether they were (a) consciously aware of the scent (i.e., "did anything seem strange about this experiment?") and/or (b) familiar with the metaphor central to the study (i.e., "what does the phrase 'something smells fishy' mean?"). All measures were completed on a computer using Qualtrics, allowing us to record the time taken to complete each section. After data collection was completed the raffle was drawn, and the prize was awarded to the winner.

Results

Data Cleaning

Two participants were not familiar with the metaphor, but as they were not in the fishy condition their data was retained (one from control, one from fart smell). None of the participants indicated that they were aware of a smell in the room. For the facial trust

measure, the data from 37 (32.74%) participants were removed from that part of the analysis due to incomplete responses to the task (missing data) or providing a consistent rating across all faces regardless of its trustworthiness valence.

Descriptive Statistics

Descriptive statistics for the individual difference variables are displayed in Table 1. Means and standard deviations were similar across conditions. Separate one-way Analysis of Variance (ANOVA) were conducted for each of the scales presented below, showing that, as expected, no statistically significant differences were found between the three scent conditions (all *p*s > .25).

Table 5.1

Means (Standard Deviations) of Personality Measure Scores as a Function of Condition

	Condition					
	Fish Oil (n =38)		Fart Spray (n =36)		Control (n = 38)	
	M	*SD*	*M*	*SD*	*M*	*SD*
Distrust	24.47	5.03	24.72	5.62	25.18	6.54
Intellect	48.13	6.48	49.19	7.37	47.02	5.34
GTS	22.58	2.41	21.94	3.55	22.05	4.20
AUT (Fluency)	8.39	3.58	7.69	3.17	7.13	3.10
AUT (Originality)	5.18	2.46	5.41	2.36	4.80	2.55

The correlations between the personality measures and AUT scores are presented in Table 5.2. There was a strong negative correlation between the General Trust Scale and the Distrust Scale, and moderate positive correlations between the AUT scores (fluency and originality) and the Intellect Scale.

Table 5.2

Pearson Correlations between the Personality Measures and AUT (N=112)

Variables	1	2	3	4
1.Distrust				
2.Intellect	-.151			
3.General Trust Scale	-.674**	.105		
4. AUT (fluency)	-.060	.219*	.076	
5. AUT (originality)	-.076	.385**	.098	.726**

Note: AUT Alternate Uses Task, *$p < .05$, **$p < .01$.

Public Goods Game

An ANOVA conducted to compare the number of tickets invested across conditions, showed that the effect of scent was significant $F(2,109) = 6.10$, $p = .003$. Post hoc analyses using the Bonferonni correction indicated that participants in the fishy condition invested fewer tickets ($M = 5.03$, $SD = 2.57$) than in both the fart spray ($M = 6.94$, $SD = 2.78$, $p = .009$) or the control condition ($M = 6.89$, $SD = 2.78$, $p = .010$), there was no significant difference between the fart spray and control condition ($p = .939$).

In order to investigate whether there was a difference in the relationship between distrust scores and the number of tickets invested between conditions separate correlations were conducted. In the control condition, as expected, there was a moderate significant negative correlation $r = -.359$, $p = .027$. However, the relationship was not significant in either the fart spray ($r = .176$. $p = .305$) or fish oil conditions ($r = -.020$, $p = .906$).

To further examine this relationship, and identify any potential interaction between distrust scores and smell condition on the number of tickets invested I conducted a moderation analysis using the Hayes PROCESS macro for SPSS (model 1) with 5000 bootstrapped samples (Hayes, 2013). For the analysis I used the number of tickets invested as a continuous outcome predictor as this type of analysis is considered robust to the non-normal

distribution (Hayes & Montoya, 2017; Williams et al., 2013). I included the smell condition as the predictor and the trust as the moderator variable. The influence of potential outliers was inspected by calculating Mahalanobis's distance (values above 13.820) and Cook's distance (values above 0.037), none of the cases met both criteria. As there was one categorical variable with three levels, dummy coding was completed (D_1 – Control = 1, Fart spray = 0, Fish oil = 0; D_2 - Control = 0, Fart spray = 0, Fish oil = 1). The overall model was significant $F(5, 106) = 3.788$, $p = .003$. R^2 =.152. Simple slopes analysis indicated that at low levels of distrust, D_2 (Fish oil) was a significant predictor of the number of tickets invested, b = -2.750, $t(106) = 2.979$, $p = .002$, and D_1 (Control) was not (p=.118). At average levels of distrust, D_2 (Fish oil) was a significant predictor of the number of tickets invested, b = -1.931, $t(105)$ = 3.140, $p = .002$, and D_1 was not ($p = .995$). At high levels of distrust neither was significant.

Wason Rule Discovery Task

I expected that those in the fishy condition would be more likely to avoid confirmatory bias, as indicated by the use of at least one negative hypothesis test, than those in the other conditions. A chi-square analysis of the number of participants in each condition to use a negative hypothesis test revealed a significant difference between groups, $\chi^2(2,111) = 11.18$, $p = .004$. Participants in the fishy condition were more likely to generate at least one negative hypothesis test (11 out of 38; 28.94%) than those in either the fart-spray condition (4 out of 36, 11.11%), or the control condition (1 out of 38, 2.63%).

Previous research has shown that those who score low on the GTS are more likely to use a negative hypothesis test on this task (Mayo et al., 2013). Table 4 shows the average GTS and distrust scale for participants who used negative hypotheses in each of the three conditions. As can be seen in Table 5.3, there were no statistical differences on GTS (or distrust) scores either across groups, $t(110) = 0.39$, $p = .690$ ($t(110) = 0.034$, $p = .973$), or within the fishy condition, $t(36) = 0.39$, $p = .699$ ($t(36) = -0.548$, $p = .628$). Unfortunately, cell

counts were too low to further analyse any potential interaction between personality scores and condition on the results of this task.

Table 5.3

Means (Standard Deviations) of Trust Scale scores as a Function of Condition and Use of a Negative Hypothesis Test (NHT) in the Wason Task

	Condition						Total	
	Fishy smell		Fart spray		Control			
NHT	Yes	No	Yes	No	Yes	No	Yes	No
	M	*M*	*M*	*M*	*M*	*M*	*M*	*M*
	(SD)	*(SD)*	*(SD)*	*(SD)*	*(SD)*	*(SD)*	*(SD)*	*(SD)*
Count (*n*)	11	27	4	34	1	37	16	96
GTS	22.82	22.48	21.25	22.03	24.00	22.00	22.50	22.15
	(*2.99*)	(*2.19*)	(*4.27*)	(*3.52*)	(n/a)	(*4.25*)	(*3.20*)	(*3.50*)
Distrust	25.18	24.19	24.25	24.78	22.00	25.27	24.75	24.80
	(*5.29*)	(*5.00*)	(*7.41*)	(*5.51*)	(n/a)	(*6.61*)	(*5.51*)	(*5.78*)

Time Taken

It was predicted that there would be no differences between groups on how long they took to complete the personality measures (pre-manipulation), and that those in the fishy condition would take longer to complete the experimental tasks (post-manipulation) than those in the other conditions. The results support the prediction. Table 5.4 shows the time taken for each section separated by condition. A one-way ANOVA, to compare scent conditions, was conducted for Time A, and Time B. There was no statistical difference between groups for Time A, $F(2,109) = 0.830$, $p = .438$. There was a significant difference between groups for Time B, $F(2,109) = 5.80$, $p = .004$. Post hoc analysis further revealed that the participants in the fishy condition took longer to complete the experimental tasks than

those in the fart-spray condition (p = .011), and those in the control condition (p = .013). There was no statistical difference between the latter groups (p = .901).

Table 5.4

Means and Standard Deviations for the Time Taken to Complete Personality Measures (Time A) and Experimental Tasks (Time B) separated by Condition, and Correlations between Times Taken for Each Condition

	Time A		Time B			
	M (SD)		*M (SD)*		*r*	*p*
Fish Oil	498.87	(313.25)	2277.79	(1690.82)	.182	.273
Fart Spray	454.97	(331.31)	1388.86	(1110.01)	-.149	.385
Control	553.26	(342.10)	1418.45	(921.91)	.312	.056

There was no significant correlation between any of the personality measure scores and the time taken to complete the experimental tasks. These results are presented in Table 5.5. Therefore, further tests for interactions were not deemed necessary.

Table 5.5

Pearson Correlations for each Personality Measure on Time taken to Complete Personality Measures (Time A) and Experimental Tasks (Time B)

Condition	Measure	Time A		Time B	
		r	*p*	*r*	*p*
Fish Oil	Distrust	.233	.159	.101	.548
(*n* =38)	Intellect	-.199	.231	-.086	.609
	GTS	.115	.490	-.232	.131
Fart Spray	Distrust	.195	.256	-.328	.051
(*n* = 36)	Intellect	.188	.272	.008	.964
	GTS	-.240	.158	.319	.058
Control	Distrust	-.189	.257	-.129	.439
(*n* = 38)	Intellect	.043	.799	.148	.374
	GTS	.043	.795	.064	.702

Facial Perception Task

It was predicted that participants in the fishy condition would rate all faces (all valences) as less trustworthy than participants in the other conditions. An initial MANOVA examined the effect of condition across the 7 face valences (DVs). The multivariate effect was not significant $F(14,132) = 0.87$, $p = .591$. Means and standard deviations are presented in Table 5.6. At the neutral valence the ratings did not differ between groups, but at the extremes there did appear to be differences between trustworthiness ratings. For the least trustworthy face, differences between conditions appear to have occurred in a way that was predicted, with those in the fishy condition rating the face as more untrustworthy than other groups. However, the overall difference between groups for this face valence was not statistically significant, $F(2,74) = 1.35$, $p = .265$. For the most trustworthy face, surprisingly, it appears

that those in the fish oil rated this face as more trustworthy than in the other conditions. However, the overall differences between groups were not statistically significant, $F(2,74) = 2.28$, $p = .110$.

Table 5.6

Means and Standard Deviations for Facial Trust Ratings separated by Condition

	Face Trustworthiness Valence *M* (*SD*)						
	-3	-2	-1	0	+1	+2	+3
Fish Oil	-17.62	-12.59	-4.40	2.79	5.98	8.40	12.40
	(*8.06*)	(*7.50*)	(*7.47*)	(*6.08*)	(7.55)	(*6.76*)	(*7.28*)
Fart Spray	-16.32	-11.86	-4.94	-0.02	5.58	7.56	9.36
	(*6.98*)	*(6.01*)	(*5.19*)	(*7.21*)	(6.69)	(*7.22*)	(*9.30*)
Control	-13.93	-11.00	-5.88	-1.12	3.05	5.17	7.43
	(*8.54*)	(*8.67*)	(*5.96*)	(*7.55*)	(*7.01*)	(*7.89*)	(*8.45*)

Within the control condition there were no statistically significant correlations between personality scales and trustworthiness ratings of the facial stimuli. These results are presented in Table 5.7. Unfortunately, it was not possible to sufficiently analyse the interaction of the distrust scores, and the effect of the fishy smell due to the small sample size (Control, $n = 21$, $N = 75$).

Table 5.7

Pearson Correlations between Personality Measures and Facial Trustworthiness Ratings within the Control Condition.

		Face Trustworthiness Valence						
		-3	-2	-1	0	+1	+2	+3
Distrust	*r*	0.084	0.151	0.161	0.148	-0.077	-0.191	-0.066
	p	0.719	0.514	0.485	0.522	0.740	0.407	0.776
Intellect	*r*	0.067	0.131	0.132	0.126	0.196	0.248	0.270
	p	0.774	0.571	0.569	0.586	0.395	0.278	0.236
GTS	*r*	0.334	0.277	0.330	0.139	0.245	0.258	0.192
	p	0.138	0.224	0.144	0.547	0.284	0.259	0.405

Discussion

The first aim of this study was to replicate previous findings that consistent with the metaphor of 'something smells fishy' that a fishy smelling prime would induce less socially trusting behaviour. As predicted, and consistent with the previous research the results of this study show that participants in the fishy condition invested fewer tickets in the public goods game and were more likely to use a negative hypothesis test in the WRDT, than participants in the other conditions. It was also hypothesised that participants in the fishy condition would take longer to complete the experimental tasks than participants in the other conditions. This hypothesis was also supported. However, the hypothesis that participants in the fishy condition would provide lower ratings in the facial trust measure, than participants in the other conditions, was not supported. These results provide empirical support for the findings that exposure to a fishy smell will induce suspicion and undermine cooperation, and that this effect is not due to the unpleasantness of the smell, but specific to the metaphor consistent smell only.

In relation to personality, it was predicted that trait distrust would be negatively correlated with a) offers in the public goods game, b) use of a negative hypothesis test in the WRDT, c) time taken to complete the experimental tasks, and d) ratings of trustworthiness for all faces presented in the facial trust measure. This hypothesis was only partially supported as the predicted relationships were only present in the public goods game.

The second aim of the current study was to investigate the potential interaction effects of trait distrust on the metaphor consistent embodied effects. It was predicted that there would be an interaction between individual dispositional trust trait scores and the observed effects of fishy smell on suspicion. Specifically, those that score low on the distrust scale would be more susceptible to the influence of the fishy smell, than those that score high. This hypothesis was partially supported. However, what I also found was that the embodied cognition effects overrode individual differences. In the public goods task, there was a correlation between distrust scores and the number of tickets given but only for those in the control condition. Participants in the fishy condition tended to behave in a similar fashion to the high distrust control participants, regardless of their distrust scores. This indicates that the metaphor consistent smell was a stronger influence on the number of tickets invested. In the WRDT though the cell counts were too low for a thorough interaction analysis, I did not find any overall trust score differences between those that used a negative test, and those that did not, as would be expected based on previous research (Mayo et al., 2013), which may again indicate that the embodied cognition effects are overriding individual differences.

Additional Measures of Suspicion

. In the time taken to complete the study analysis I found a correlation between the time taken to complete pre-test measures and experimental tasks that approached significance in the control condition only. Indicating that participants may be generally consistent in the time they take on tasks. However, this potential correlation completely disappeared in the fishy condition, again indicating that the smell is a more dominant influencer. Though they

did not specifically measure time taken Jessup et al., (2020) recently demonstrated that primed suspicion (study1) and primed distrust (study 2) both led to participants providing longer (word count) responses to an elicitation task. Consistent with the results from the current study, it would be expected that this also led to taking longer to complete the task.

In the facial perception task, it was predicted that participants in the fishy condition would rate faces lower in trustworthiness across all valences, than the participants in the other conditions. While the results did not support this hypothesis, the pattern that seems to be emerging is that compared to participants in the other groups, participants in the fishy condition rate untrustworthy faces as more untrustworthy, neutral faces the same, and surprisingly, trustworthy faces as more trustworthy. Though the results did not support my prediction, there is some recent literature that suggests that the trend is not completely surprising. Calabrese et al., (2017) using the same GTS, demonstrated that those high in dispositional distrust were more accurate at discriminating between trustworthy and untrustworthy faces. This suggests that distrust is adaptive in that it helps "in avoiding poor social exchange partners (untrustworthy targets) without missing out on true cooperative opportunities (trustworthy targets)" (Calabrese et al., 2017, p. 37). Furthermore, the results indicate that there was no difference between trustworthiness ratings for the neutral face which was unexpected as based on previous literature (Calabrese et al., 2017) it was predicted that those in the fishy condition would set a higher criterion for what constitutes a trustworthy face, and as such rate the neutrally valenced face us untrustworthy. Chandler et al, (2012) have suggested that incidental sensory information can provide supporting evidence for our decisions, rather than being used as last resort (i.e., under ambiguity). This would explain why ratings provided by participants in the fishy condition were more pronounced at the extreme ends of the facial stimuli valences, than participants in the other conditions, and no different for the neutral face.

The broader purpose of this study was to independently replicate and to also contextualise the fishiness-suspicion effect, by considering how it would be limited, or constrained, by individual differences. However, the findings suggest that the embodied effects were not constrained at all. Rather the effect of the metaphor consistent smell was sufficient to override the influence of individual difference factors (i.e., trait distrust). The inclusion of the fart-spray condition in this study for the WRDT (which was not included in the original study) provides further empirical support that the effect is due to the metaphor consistent smell. Thus, this independent replication with a non-U.S. based sample was successful, and additional knowledge, and empirical support, has been added to the understanding of embodied cognition and conceptual metaphor theory.

Limitations and Future Research

While the results of this study indicate that individual difference factors may be secondary to embodied cognition effects, I do not necessarily believe that this would remain true for all types of individual differences, or even dispositions. Recent research has shown that Need for cognition described as "the tendency for an individual to engage in and enjoy thinking" (Cacioppo & Petty, 1982, p.116) may play a role in embodied cognition effects, but only when there is substantive information present (Hauser & Schwarz, 2015). Participants in their study who scored high on the Need for cognition were more likely to be influenced by the metaphoric link between weight and importance (i.e., a book; Jostmann et al., 2009), but only when there was more information available (i.e., back cover synopsis). This indicates that there are individual difference factors that do play a role in embodied cognition effects, and future research should seek to find what these factors may be, and when and where they may, or may not, be involved.

Unfortunately, this sample was insufficient in size to allow a thorough analysis of the potential interaction between trait distrust, or trait intellect, and confirmation bias in the WRDT. A power analysis was conducted in the design phase, but it was based on much

higher estimates from previous findings of the use of negative testing than this study actually obtained. This has been put down to a reduced number of chances to hypothesis test, and poor wording of the online instructions. I also obtained insufficient data in the facial perception task due to a high proportion of invalid responses. Future research should be adapted to account for these factors, along with more conservative estimates in the power analysis.

Though not a focus of this thesis, the results also indicate a differentiation between the constructs of distrust and suspicion. The predictions made for state suspicion and trait distrust across all outcome measures was the same. However, the findings were inconsistent indicating that they are distinct constructs with distinct effects.

Conclusion

A key aim of this study was to investigate the potential constraining effects of individual differences on metaphor consistent embodied effects. Though an interaction between these effects was found, the results suggest that that individual differences may be overridden by embodied cognition effects. Future research is recommended to examine if these findings are particular to this metaphor, or possibly limited to metaphors primed by the olfactory senses. It is also suggested that larger samples are obtained to sufficiently test the interactions across all measures. The results of this study also provided empirical support for previous research using an Australian sample and explored additional outcome measures for suspicion.

Chapter 6 : Stimuli piloting for Study 2

The first empirical study provided an independent replication of the previously demonstrated metaphor consistent embodied effect of exposure to a fishy smell on inducing suspicion and undermining cooperation (i.e., Lee & Schwarz, 2012). While the obtained results provide some empirical support for the field of embodied cognition and conceptual metaphor theory, further replications are required involving larger and more culturally diverse samples (Borghi & Fini, 2019), to add weight to these findings. However, physically exposing participants to specific sensory motor experiences (i.e., a fishy smell) in face-to-face experiments can be quite time and resource intensive. A potential solution to this problem is to develop methods that utilise online testing participant pools (i.e., Cloud Research), but in order to do this for non-visual related metaphors cross-modal priming will be necessary.

Cross-Modal Priming

Cross-modal priming is central to the embodied cognition perspective which posits that representations are multi-modal and specific to sensory experience (e.g., Schwarz & Lee, 2018). Empirical support for cross activation of modalities has been demonstrated in neuroimaging studies that found that reading words (i.e., visual modality) can activate the associated sensorimotor neural regions (Hauk et al., 2004). For example, viewing images of food (i.e., a cookie) activates gustatory regions (Rolls, 2005; Simmons et al., 2005). Similarly, reading the words “jasmine”, or “cinnamon” elicits activation in the primary olfactory cortex (Gonzales et al., 2006), this cross modal activation has been shown when reading literal (i.e., “The food smells burnt”) and metaphorical sentences related to scent (i.e., "It clearly smells of trouble"; Pomp et al., 2018). As such, it could be argued that an image of a “smelly fish” may be sufficient to cross activate the relevant representation grounded in the olfactory cortex and prime the fishiness-suspicion link.

There is minimal previous research that has attempted to cross-modally prime a conceptual metaphor. However, there are some existing studies that have successfully

demonstrated the effects that the current study aims to obtain. For example, Levontin et al., (2015) found that MTurk participants who watched a video of a bag being emptied as a prime of resource depletion were focused more on themselves and less on others than participants who watched a video of a bag being filled consistent with metaphors such as "running on empty" (Coveney et al., 2009). They suggest that observing the act of emptying (i.e., empty pockets, empty handed) can activate the conceptually related threat of resource depletion, and a focus on care for the self. This was demonstrated by the participants allocating more money to themselves than others. Also having their MTurk participants watch a video, but this time displaying fluid, nonfluid, or no movement researchers found an association between fluid movement (concrete) and fluid thought (abstract) concerning the rigidity of racial stereotypes (Slepian et al., 2014). In both the Levontin et al., (2015) and Slepian et al., (2014) articles the researchers conducted multiple studies to demonstrate and support their findings using both online data collection (using cross-modal priming), and live face-to-face lab studies (using modal specific physical primes), with the latter showing consistently stronger effects. This suggests that direct priming via the metaphor relevant sensory motor experience is more effective than cross-modal priming.

In a more recent study, Park and Hadi (2020) used images of landscapes to prime the metaphor of warmth and coldness via visual depiction of physical temperature of the same tree in winter (snow covered) or summer (lush and green). They first demonstrated a metaphor consistent association between feeling physically cold (lab participants held either a room temperature or a refrigerated vase) and perceptions of high social status, which they suggest are connected as coldness is metaphorically related to social isolation, and by extension social exclusivity. For example, those with high social status can be seen as cold and aloof (both physically and metaphorically distant; Gentner et al., 2001). They then had MTurk participants rate the status of a commercial product (fragrance; luggage) which was presented in front of either the winter or summer tree. Similar to the actual experience of

temperature, participants that viewed the products with a winter tree in the background (cold) perceived the products to be more exclusive and luxurious, than participants that saw the products with a summer tree in the background. Results from their online study using the tree images were consistent with the lab study results, though the effect sizes were weaker, suggesting that the embodied cognition effects may be weakened by priming cross modally.

The aim of my second empirical study was to investigate whether the fishiness-suspicion link, which is grounded in the sensory modality of olfaction, could be primed using visual stimuli. As such a more in-depth discussion of the theoretical background for this possibility will be discussed in the following chapter. The purpose of this chapter is to provide an overview of the piloting process conducted to identify and develop stimuli to activate the representation of "fishiness".

The embodied cognition perspective posits that representations are multi-modal and specific to sensory experience (e.g., Schwarz & Lee, 2018). For example, the various sensory experiences of 'fish' would be stored separately in multiple neural areas associated with each of the senses (i.e., smell in olfactory cortex). Consistent with this, my first empirical study showed that the smell representation of fishiness can activate a conceptual link with suspicion. However, other representations of fishiness (i.e., visual/image) may also activate this link. Arguably, though not directly tested within this thesis, what I reason is that all stimuli may activate multiple other modal representations, including the smell representation of fishiness. As a result, I reasoned visual stimuli would also prime the smell representation which would then activate the conceptual link between fishiness and suspicion.

Methodological Considerations

In developing the stimuli for pilot testing there were two main initial questions; what to present, and how to present them. There is minimal research that has attempted to cross-modally prime a conceptual metaphor. As such, there were no guidelines or criteria on what type of images may work best as cross-modal primes. For this reason I took a very broad

perspective on image selection for pilot testing. I decided to present four different categories of images (what) from three perspectives (how). The four categories of images were; smelly fish, fresh fish, fresh shoes, and smelly shoes. The three perspectives are; *egoistic*, *observational*, and *object alone.*

Image Categories

In order to prime the effects previously demonstrated with a "fishy smell" the obvious first category of image is that of a smelly fish. Next, I have included the category fresh fish to explore if the effect is specific to a smelly fish or can be activated by 'fish' in more general. In line with previous research, and my first study, which included a control condition (water) that did not involve any smell, and a comparator condition (fart spray) that controlled for the unpleasantness of the fishy smell without being metaphor consistent, it seemed appropriate to control for similar factors in a cross-modal experiment. Thus, a 2 (smelly, fresh) x 2 (fish, not fish) design was used. As it seemed impossible to depict a fresh fart, I decided to go with fresh (i.e., new) shoes and smelly shoes. Consistent with the fart spray condition in the previous study smelly shoes, if the proposed experiment is successful, would demonstrate that the effect of increased suspicion is not due to the unpleasantness of the smell, but specific to the metaphor consistent smell only. As the metaphor appears specific to 'smelly fish' the fresh fish images should also be metaphor-inconsistent and as such should also not have an influence on suspicion related decisions. Furthermore, the inclusion of fresh shoe images (also metaphor inconsistent) allowed the desired factorial design.

Image Perspectives

In the current piloting study images from each category were presented from different perspectives. These perspectives have been selected based on previous research investigating the metaphor consistent embodied link between physical and social warmth (e.g., Williams & Bargh, 2008). This link was most notably demonstrated in an experiment by Williams and Bargh (2008) where participants that briefly held a warm cup of coffee provided more

positive judgments of a stranger (i.e., warm and caring) than participants that held a cold cup of ice coffee. The first perspective that images will be presented in is an egoistic perspective. In a conceptual replication of the Williams and Bargh study, the same effect was found when participants imagined themselves holding the relevant cup from a first-person perspective (egoistic), but not when participants imagined viewing themselves holding the relevant cup (i.e., from a third personl perspective; Macrae et al., 2013). Although this was an imagined experience rather than a static image it provided a place to start.

The next perspective I included in the piloting study was an observational perspective. This perspective involved participants viewing images of another person experiencing the target category. The inclusion of this perspective is based on research (Rai et al., 2017) that provided temperature cues by presenting participants with images of people feeling either physically warm or cold. The manipulation was found to be successful as those in the warm condition indicated a higher intention to donate to a charity than those in the cold condition, as would be expected from a metaphorically warm (i.e., caring) person. The effectiveness of this image perspective was linked to the presence of mirror neurons, whereby observing another person experiencing a situation (e.g., seeing a face expressing disgust) stimulates similar neural experience as actually experiencing the situation yourself (Wicker et al., 2003). As such, viewing an image of another person experiencing the target condition may simulate the experience in the observer.

The final perspective to be included in this study I have termed the object alone perspective. This involved an image of the target category with no person present. Park and Hadi (2020) manipulated the perceived experience of physical warmth and cold by presenting participants with an image of a tree in winter, or a tree in summer (dependent on condition). Though their outcome measure related to higher social status was arguably only tenuously linked to social coldness, their manipulation was successful.

The Pilot Study

Pilot testing was conducted in two stages. In stage 1 target category images (i.e., smelly fish, fresh fish, smelly shoes, fresh shoes) from each perspective were shown to the participants individually (images seen one at a time), and they were asked "what words or thoughts come to mind when looking at this picture?" In the second stage participants were shown a block of the images of each category presented together (i.e., egoistic smelly fish, observational smelly fish, and object alone smelly fish) and asked which of the images best represented the target concept (i.e., smelly fish).

Based on the literature reviewed it was tentatively predicted that images presented from an egoistic perspective would be perceived by participants as a better representation of the target category, than images presented from an observational, or object alone perspective. If my reasoning is correct then images from all perspectives should be judged as being related to the relevant category, however, I predict that images from an egoistic perspective would be the most effective.

Method

Participants

Sixty-five participants were recruited from a sample of convenience and ACU students participating in exchange for course credit. As this was a preliminary stage of testing, no personal demographics were collected. Four participants removed themselves from the study prior to providing sufficient data for analysis. Therefore, 61 participants were included in this stage of testing.

Measures

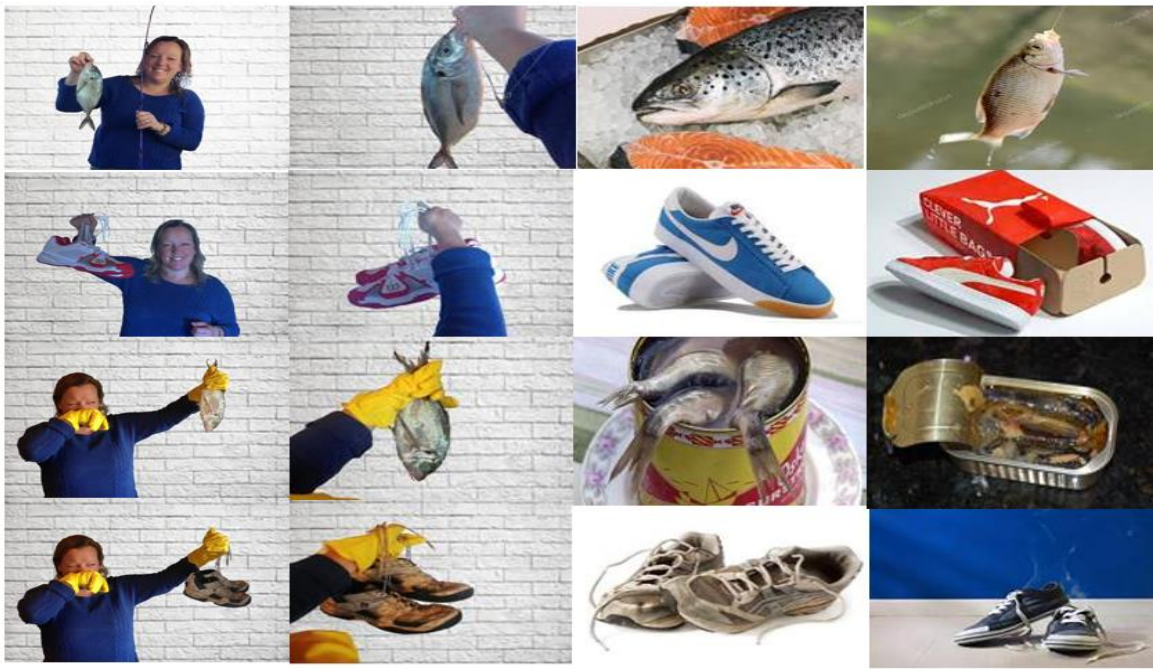
Thought Listing Task (e.g., Cacioppo et al., 1997). Participants were presented with individual images (one at a time) statically on screen with the open format question "what words or thoughts come to mind when looking at this picture". Responses were categorised in

relation to the key concept words (i.e., smelly, fresh, fish, shoe), and then the percentage of participants that used terms related to each key concept word for each image was calculated.

Image Stimuli. Images were all presented in a large size (600px x 450px) and remained on screen until the participant was ready to proceed to the next image. There were 2 picture target (fish and shoe) and 2 smell conditions (smelly and fresh). For each of these (i.e., smelly fish, fresh fish, smelly shoes, and fresh shoes), there were 4 types of image perspectives(i.e., observational, egoistic, object alone set A, and object alone set B), which resulted in a total of 16 images (see Figure 6.1). To avoid boredom effects each participant was presented only two image perspectives (8 images). Unfortunately, due to an error in programming Qualtrics each participant saw the egoistic image set and one of the other three sets.

Figure 6.1

Observational, Egoistic, Object Alone set A, and Object Alone set B Perspective Images (presented from left to right)



Best match task. Using the same images as those used in the thought listing task participants were presented with all four images from each category (i.e., a complete row

from Figure 6.1) on the one screen and asked which image (perspective) they thought best represented the key concept. There were four blocks of images presented, one for each of the key concepts (e.g., smelly fish).

Procedure

After providing informed consent, participants were asked to provide an id number (last five digits of their phone number) and then asked to complete the thought listing task for two image perspective sets (8 images presented individually). They then responded to the best match task (images presented in sets). Participants were then thanked for their time. On average the survey took six and a half minutes to complete.

Results

The number of times a participant listed a key word in their description of each image was categorised and tabulated. Percentages are shown in Table 6.1. As can be seen in the table, when viewing the smelly fish image from an observational or object alone perspective, participants frequently used words related to smelly, and no participants used words related to fresh. However, the same was not found when viewing the smelly fish image from an egoistic perspective. A simple visual inspection of the results indicated that the observational perspective images were more effective in activating the associated concepts than the egoistic perspective images. The object alone images from set A appeared to be more effective than the object alone images from set B.

Table 6.1

Percentage of Participants that Stated the Key Concept Word when Viewing the Image

Image type	Category	% of participants using a key term			
		Smelly	Fish	Fresh	Shoes
Observational	smelly fish	87.50	62.50	-	-
(*n* = 16)	fresh fish	6.25	81.25	31.25	-
	smelly shoes	93.75	-	-	62.50
	fresh shoes	13.50	-	6.25	81.25
Egoistic	smelly fish	39.34	42.62	5.92	-
(*n* = 61)	fresh fish	16.39	65.57	29.51	-
	smelly shoes	36.07	-	-	24.60
	fresh shoes	6.56	-	59.02	45.90
Object Alone set A	smelly fish	58.33	75.00	-	-
(*n* = 24)	fresh fish	25.00	83.33	25.00	-
	smelly shoes	83.33	-	-	62.50
	fresh shoes	8.33	-	79.17	66.67
Object Alone set B	smelly fish	61.90	80.95	-	-
(*n* = 21)	fresh fish	14.29	66.67	9.52	-
	smelly shoes	47.62	-	-	57.14
	fresh shoes	4.77	-	76.12	61.90

As seen in Table 6.1 above, the majority of participants used fresh related words when viewing the fresh shoes images from all perspectives except the observational perspective. Closer examination of the responses revealed that participants seemed to be put off by the size of the shoes, with many participants suggesting that they were too big, and ‘not hers’, rather than focusing on their being fresh/new. As shown in Figure 6.2, using Adobe photoshop these

particular images were manipulated to have the model holding new shoes that would be likely to belong to the model. The original observational fresh shoes image was replaced by the adapted image from this point.

Figure 6.2

Original Observational Fresh Shoes Image on Left, and New Manipulated Image on Right.

The results for the best match task are presented in Table 6.2. For the smelly fish, smelly shoes, and fresh shoes concepts, the observational images were selected as the best representation. However, for the fresh fish concept the object alone set A image was the best representation, and only six out of 34 participants selected the observational version. Based on these mixed results, it was decided to include all image perspectives in the second part of stimuli testing, though only one set of object alone images (Set A) was included.

Table 6.2

Tabulated Results from the Best Match Task

Concept	Picture Category	% selected	Rank
Smelly Fish	observational	73.53	1
	egoistic	8.82	3
	object alone set A	17.65	2
	object alone set B	0.00	4
Fresh Fish	observational	17.65	3
	egoistic	0.00	4
	object alone set A	61.76	1
	object alone set B	20.59	2
Smelly Shoes	observational	73.53	1
	egoistic	5.88	3
	object alone set A	14.71	2
	object alone set B	5.88	3
Fresh Shoes	observational	50.00	1
	egoistic	2.94	3
	object alone set A	44.12	2
	object alone set B	2.94	3

Interim Discussion

The aim of the first stage of pilot testing was to identify which images would best represent the target concepts. It was tentatively predicted that images presented from an egoistic perspective would be a better representation of the target, than images presented from an observational, or object alone perspective. This hypothesis was not supported, as the images from the observational perspective were perceived as the best representations of

smelly fish, smelly shoes, and fresh shoes, based on the tabulated findings. However, the fresh fish category from an object alone (set A) perspective was chosen as the best representation of that category.

The finding that the egoistic perspective images were ranked lowest, or second lowest, across all target categories was surprising given that it appeared to have the strongest support from previous embodied cognition research (i.e., Lorey et al., 2009; Macrae et al., 2013). My initial consideration of using this perspective was partially based on gaming research, where players using a first-person-point-of-view (egoistic) have been shown to be much more immersed in the experience than players using a third-person-point-of-view (observational), demonstrated by differences in physiological responses, perceptions of presence, and identification with their avatar (gaming character; Ferchaud & Sanders, 2018). “To assign a first-person-perspective is to centre one’s own multimodal experiential space upon one’s own body, thus operating in an egoistic reference frame” (Vogeley & Fink, 2003, p. 38). However, it is very likely that this immersion develops over game time, rather than occurring from a single frame picture (static image).

The findings from the first stage of piloting indicated that images from an observational perspective were the most promising in terms of activation of related concepts, as images from this perspective were ranked highest in terms of best representing the relevant category for all image categories except fresh fish. The inclusion of this perspective in the first stage of piloting was based on research that had participants view images of people feeling cold or warm (Rai et al., 2017). I did not predict this perspective to be particularly effective as in the previous research (Rai et al., 2017) they followed image presentation by asking participants to write about how they themselves would feel in the pictured situation, which seems to match better with an egoistic perspective. However, the current findings are not inconsistent with an embodied view as merely observing has been shown to activate similar modality specific neural activity as actual experience (Wicker et al., 2003). For

example, seeing the model expressing disgust while holding the fish may have triggered a similar disgust in the observing participant.

Given the somewhat unexpected results from the pilot study, I determined that further stimuli testing was warranted. The results indicate that the observational perspective had reasonably strong support, and that support for the egoistic perspective was quite weak. While I had initially planned to remove the weakest perspective from further testing, after examining the current results I decided to retain the egoistic perspective as an additional comparison point for any findings in the second stage of piloting. However, I did remove the object alone set B images as the object alone set A images were consistently ranked higher across all target categories.

Introduction to Further Piloting

In order to determine if the relevant image activates the associated concepts, I utilised a lexical decision task. In this task, participants were non-consciously presented with the image and then required to classify letter sequences as words or nonwords. This task is based on the presumption that words that are conceptually associated with the image will be responded to faster than non-associated words. This is considered evidence that the image stimuli have activated the associated concepts in memory (Meyer & Schvaneveldt, 1971; Sekulak & Maciuszek, 2017). Based on the reasoning that primed concepts will be more accessible, and therefore responded to faster, than non-related concepts.

Over the last 40 years priming has been used extensively within social science research (Janiszewski & Wyer, 2013). Priming refers to the process in which “an initially encountered stimulus is shown to influence a response to a subsequently encountered stimulus” (Janiszewski & Wyer, 2013, p. 97). If the stimuli are related their accessibility will be increased and more likely to influence behaviour or decisions and can occur without conscious awareness. For example, using a picture-word priming task Valenzuela and Soriano (2007) found that participants when presented with an image metaphorically related to

emotions (e.g., an erupting volcano) were faster to correctly classify anger as an emotion (rather than as a tool or fruit) than when presented with an image of fruit (e.g., a pineapple). In this case the priming effect occurred because an erupting volcano is metaphorically associated with the concept of anger and seeing the erupting volcano image increased the accessibility of the anger concept. While priming effects can be demonstrated using various methods (i.e., behavioural priming; Janiszewski & Wyer, 2013) in this study I have chosen to use a variation of the lexical decision task.

The classic lexical decision task uses word/text as both stimuli and targets (Meyer & Schvaneveldt, 1971), for example, the word *Nurse* will be responded to faster if primed with an associated word such as *Doctor*, than if primed with an unrelated word such as *Toast* (i.e., Perea & Rosa, 2002). This effect has also been demonstrated when the primes are presented below the threshold of perception (less than 500ms; Elgendi et al., 2018). For example, participants subliminally primed with the word *Up* (shown for 34ms) were faster to respond to positive words like *Happy*, than metaphor incongruent words like *Sad* (Ansorge et al., 2013).

Findings from research using lexical decision tasks have been used to provide support for the embodied cognition view on mental representation (Pexman, 2012). From an embodied perspective sensorimotor experience is fundamental to the acquisition, storage, and processing of conceptual knowledge, and thus involves multiple modalities (e.g., Barsalou, 1999). The recall of conceptual knowledge will therefore include partial activation of the relevant sensorimotor systems. “As such, lexical decisions are facilitated for words that evoke relatively more sensorimotor knowledge … than for words that evoke less sensorimotor knowledge” (Pexman, 2012, p. 37).

Lexical decision tasks have been previously used to demonstrate metaphor consistent embodied effects (e.g., Wang & Chen, 2019). For example, using a more unusual version of a lexical decision task, participants who were consuming a sweet drink (i.e., the sweet prime) were faster to correctly identify romance-related words as words than non-romance words

(Wang & Chen, 2019). This effect was not shown for participants that were consuming a tasteless drink (i.e., water; Wang & Chen, 2019).

The Current Study

In this stage of pilot testing I used the target category images (i.e., smelly fish, fresh fish, smelly shoes, fresh shoes) from each perspective (i.e., observational, egoistic, and object alone), from the previous section as masked priming stimuli in a lexical decision task. For this task, there were 64 words (and 64 matching non-words) that were selected to fit the categories of negative, neutral, smelly, and suspicion. The design of this study was based on previous research in relation to the number of target words (Van den Bussche et al., 2009; Wang & Chen, 2019) and the timing of stimuli presentation (Van den Bussche et al., 2009).

It was predicted that viewing an image of a smelly fish would activate the concept of suspicion. Such that suspicion related words would be responded to faster after viewing a smelly fish, than after viewing a fresh fish, fresh shoes, or smelly shoes image.

Technically I will be using a cross-modal masked picture-word priming task (i.e., Kircher et al., 2009). However, I have refrained from using this term here as in the rest of this thesis the term cross-modal refers to across sensory motor modalities (i.e., taste/drink vs. vision/text), whereas here it refers to stimuli across but within the vision modality (i.e., looking at a picture vs. reading a word).

Method

Participants

One hundred and forty-three undergraduate ACU psychology students (M = 27.25, SD = 9.81) participated in return for partial course credit. The sample consisted of 41 males, 103 females (72.03%), and one participant that did ‘not wish to say’. The vast majority (91.72%) were residing in Australia at the time of the study, and the majority of participants were born

in Australia (70.08%). All participants stated that they were fluent in English, consistent with requirements for studying at ACU.

Not included in the sample described above were seven participants that were removed from the analyses as they either did not begin the lexical decision task or dropped out before having completed less than 25% of the trials. A further four participants were removed for having unusually high error rates (>40%), and another six participants were removed for being exceedingly quick with response times <200 ms on >40% of their trials (Fischer et al., 2011; Simcox & Fiez, 2014; Wang & Chen, 2019).

Measures

Demographics. Participants were asked to report their age, gender, country of residence, fluency in English, and handedness.

Lexical Decision Task. This task is a measure of the associations between concepts (Meyer & Schvaneveldt, 1971). In this task participants were primed with visual stimuli and asked to make a decision on whether a string of letters represented a word or non-word. The words presented belonged to certain categories. If the prime is effective then certain categories will be responded to faster than other categories. In this task, there were three image perspectives (observational, egoistic, and object alone) plus a blank image which was used as a control. There were also four categories of image stimuli within each type (smelly fish, fresh fish, smelly shoes, fresh shoes), and four categories of target words (negative, neutral, smelly, suspicion). Images are shown in Figure 6.3.

Figure 6.3

Image Stimuli Used in the Lexical Decision Task

Note: Observational perspective images on top row, object alone perspective images on bottom row. Egoistic perspective images shown on middle row.

Target Words for Lexical Decision Task. An extensive list of words fitting the categories of negative, neutral, smelly, and suspicion, was compiled. From this list I tried to select words for each category that matched the words across categories in terms of number of letters and syllables. This resulted in a list of 64 words (16 from each category) as shown in Table 6.3. Then I created matching non-words for each of the 64 words on the list. This was done by swapping letters from the original word, ensuring that they were all pronounce-able (orthographically legal; i.e., drave), and not actual words. Finally, eight words (and their paired non-word) from the original 16 were selected from each category that I felt best fit the target concepts, and also fit/matched across categories in terms of number of letters, syllables, and commonality. This left a total of 64 word stimuli (32 words and 32 non-words), which were presented in black lowercase Arial font *(*size 3.52%) on a white screen.

Table 6.3

Sample of Words Compiled for the Lexical Decision Tasks. Words in Bold Were Used in the Tasks

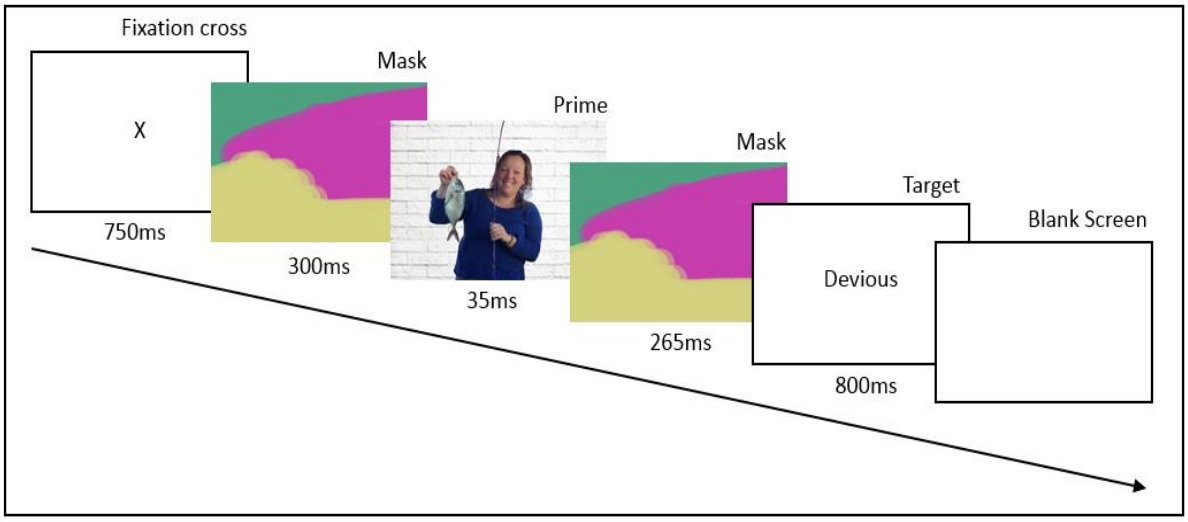
	Smell		Suspicion		Neutral		Negative	
Group	word	distractor	word	distractor	word	distractor	word	distractor
1	**smelly**	**glunky**	**sly**	**gre**	table	tadle	slave	drave
	foul	**fiel**	**shifty**	**shoily**	**echo**	**ento**	**murder**	**merder**
	funky	**tussy**	**wary**	**wany**	**ounce**	**ouffe**	terror	tebtor
	slimy	drapy	**sceptic**	**sleptic**	knife	swisp	**blame**	**blape**
2	stinky	slonky	suspect	sutlall	**chair**	**chasp**	error	ebtor
	rancid	**ranbud**	**dubious**	**duwrous**	aisle	ayels	**poison**	**pokbon**
	sweaty	queaty	slippery	slatsett	sphere	phlere	fail	ferk
	fetid	felid	dodgy	perty	dozen	pezen	**dispute**	**dispuse**
3	rank	vaft	**shady**	**brady**	various	canious	**cancer**	**canfer**
	whiffy	whirdy	careful	cansful	**fork**	**foft**	crime	frech
	gag	**pag**	cagey	cadey	**hat**	**har**	**lie**	**loi**
	putrid	**puquid**	crafty	crofty	**note**	**nole**	**vicious**	**vikious**
4	reek	teek	**devious**	**dewrous**	**carton**	**bansin**	corpse	coirse
	noxious	**pontus**	leery	leeny	trend	trent	**destroy**	**destlim**
	scent	scend	slimy	drimy	spoon	mcear	gloom	skeer
	gas	**nas**	**sneaky**	**queaky**	**margin**	**mardin**	tears	loodl

Within Trial Timing. The timing of stimuli presentation was based on previous research using a similar method (Ansorge et al., 2013), and programmed in Inquisit. Reaction time was measured from the presentation of the target word (see Figure 6.4). Each trial began with a fixation cross centred on a blank white screen presented for 750ms, followed by a forward mask for 300ms, then the image stimuli (prime, size 853px x 640px) for 35ms, then a backward mask for 265ms. The word (or non-word) then appeared on the screen for a

maximum of 800ms (replaced with the blank screen if no response was made), or until the participant had made a valid response.

Figure 6.4

Sequencing of a Typical Lexical Decision Task Trial



Note: Temporal sequence illustrated by the oblique axis. Stimulus duration stated under each box.

Procedure

Ethics approval for the study was obtained prior to any data collection. This included approval of all stimuli used in the study. Participants provided informed consent, and demographic information before being redirected to a separate Inquisit link based on their handedness, where they completed the Lexical Decision Task. Right-handed participants needed to respond to words by pressing the 'I' key if they judged the string of letters to be a word (dominant hand), or the 'E' key if it was a non-word. Left-handed participants were required to respond in reverse fashion. Prior to beginning the task proper, participants completed 12 practice trials. Participants were automatically informed of each trial result by either an 'ERROR' or 'CORRECT' message appearing on screen. Trials were completed in four separate 256-trial blocks, and participants were free to take a self-paced break in between. Each trial block consisted of one image perspective (e.g., observational, egoistic,

object alone, or blank/control), such that every image category (e.g., fresh fish, smelly fish, fresh shoe, smelly shoe) was presented once with every word (32 words and 32 non-words). The entire study took participants on average 25 minutes to complete.

Results

Data Cleaning and Assumption Checks

After removing results for practice trials, non-word trials, and trials on which participants responded incorrectly, I followed a trimming procedure similar to that used in recent research (i.e., Aschenbrenner & Yap, 2019; Gilder & Heerey, 2018). Firstly, trials with response times <250ms and those >3000ms were removed. Next, overall latency means and standard deviations were calculated for each participant across all trials. Then participant scores more than 3*SD* above the participants individual mean were also removed. This trimming procedure was conducted to avoid undue influence of outliers and involved the deletion of 3.10% of the total trial data (Aschenbrenner & Yap, 2019; Balota et al., 2008). Response time means (latencies) were calculated by first calculating the average reaction time for each word for each participant, then getting the average reaction time across all words within each category for each participant, and then finally calculating the average for each category across participants.

Descriptive statistics and normality plots were produced in SPSS for the 48 independent variables (i.e., reaction times for each factor combination). Though there were some outliers, which caused minor skewness on 19 of the 48 latencies, these were considered acceptable as these scores were aggregated from 1000's of individual trial response times and may be considered true responses, and the sample size was sufficiently large for the ANOVA to be considered robust to minor deviations from normality (i.e., $N > 40$, Central Limit Theorem; Field, 2017). Further visual inspection of the histograms and q-q plots did not

indicate any major concerns (deviations from what would be expected). The assumption of Independence of observations was met by the design of the study.

Next, I used Mauchly's test to check the assumption of sphericity. This assumption was met for picture category, and word type, but not for picture type or any of the interactions. Based on the recommendations of Field (2017) I reported effects that violated this assumption using the Huynh-Feldt correction.

Descriptive Statistics

Means and standard deviations for the response times are presented in Table 6.4. Words related to suspicion appeared to be responded to slower than other word categories across all picture categories and picture types. Overall, the slowest response time was for suspicion words when the smelly fish object images were used as the prime. Words from all categories were correctly identified faster and with less variability in response time in the blank (no image) condition than when an image was used as a prime.

Table 6.4

Means and Standard Deviations of Response Times in the Lexical Decision Task

		Negative		Neutral		Suspicion		Smelly	
		M	(SD)	M	(SD)	M	(SD)	M	(SD)
Object Alone	Fresh Fish	583.75	(120.17)	575.46	(130.26)	630.52	(125.07)	620.75	(106.06)
	Smelly Fish	575.92	(104.98)	575.08	(100.55)	672.15	(175.90)	612.19	(125.41)
	Fresh Shoes	570.92	(108.80)	586.48	(101.06)	613.20	(123.67)	615.44	(196.76)
	Smelly Shoes	588.65	(114.97)	572.67	(86.65)	629.43	(139.44)	599.38	(118.68)
Observational	Fresh Fish	568.57	(84.56)	598.03	(102.49)	617.89	(137.82)	632.69	(124.88)
	Smelly Fish	582.16	(93.19)	586.67	(102.24)	629.91	(143.63)	627.66	(136.00)
	Fresh Shoes	590.91	(102.33)	596.32	(120.40	609.93	(93.81)	617.01	(117.90)
	Smelly Shoes	589.58	(107.04)	585.20	(103.14)	611.90	(130.64)	616.56	(106.82)
Egoistic	Fresh Fish	571.20	(97.92)	584.57	(95.80)	625.28	(115.60)	620.28	(139.39)
	Smelly Fish	575.45	(119.99)	587.19	(112.23)	628.70	(127.07)	607.73	(115.93)
	Fresh Shoes	584.29	(103.76)	587.94	(98.18)	616.34	(110.7)	610.97	(118.42)
	Smelly Shoes	579.73	(97.44)	593.99	(133.94)	630.45	(126.86)	614.94	(133.74)
(Blank)		562.97	(80.12)	573.35	(76.46)	583.20	(112.8)	574.34	(98.69)

Inferential Statistics

A repeated-measures 3 (picture category) x 4 (picture type) x 4 (word type) factorial ANOVA was conducted to analyse the differences between response times. Overall there was a significant effect of word type $F(3, 93) = 12.35$, $p < .001$, $\eta^2 = .285$, but no significant effect of picture category $F(2, 62) = .01$, $p = .993$, or picture type $F(2.46, 76.27) = 0.54$, $p = .623$. Post hoc comparisons for word type indicated that suspicion words ($M = 608.46$, $SE = 19.50$) were responded to significantly slower than negative words ($M = 576.65$, $SE = 15.89$, $p < .001$), and neutral words ($M = 583.42$, $SE = 17.52$, $p < .001$). Smelly words ($M = 602.24$, *SE*

= 17.66), were also responded to statistically slower than negative words ($p < .001$), and neutral words ($p < .010$). There were no other significant differences between groups.

There were no statistically significant interactions with word type. There was no interaction between word type and picture category, $F(3.80, 117.67) = 0.52$, $p = .716$, or between word type and picture type, $F(4.76, 147.65) = 0.90$, $p = .477$. Or a significant three-way interaction, $F(7.67, 237.72) = 1.13$, $p = .345$.

Discussion

The aim of the pilot study was to identify the most suitable images to use in the second empirical study. In the first stage of pilot testing, in contrast to the prediction that images presented from an egoistic perspective will be perceived by participants as a better representation of the target category, than images presented from an observational, or object alone perspective, it was found that the observational perspective was the most effective for the majority of target categories (all except fresh fish). In the second stage of pilot testing I predicted that viewing an image of a smelly fish would activate the concept of suspicion, as demonstrated by faster response times in the lexical decision task to suspicion related words, than non-suspicion related words. This hypothesis was also not supported.

The results of the first part of this study indicated that the images selected brought to mind the key intended concepts (e.g., smelly fish), but the results from the second stage of testing indicated that they may not have been sufficient to activate the metaphorically related concepts. In theory, when a concept is primed then associated concepts will be more easily accessible, and therefore related concepts will be responded to faster in the Lexical Decision Task (Meyer & Schvaneveldt, 1971). This would imply that when a smelly fish image is presented as a prime then words associated with suspicion should be responded to faster than when another image (e.g. fresh shoes) was presented as the prime. However, the results from this study indicated that suspicion words were responded to slower than other categories of

words, and particularly in the smelly fish prime conditions. Though these differences were not statistically significant, it was the opposite pattern, or trend, to what would be expected. It seems like the suspicion words themselves may be eliciting suspicion which may delay responding. This would be consistent with the finding from the first empirical study that participants in the fishy smell condition (i.e., suspicious) took longer to complete the task than participants in the other conditions, which may have been due to suspicion causing hesitation, or greater consideration of information. This may be reflected here in the unexpected results pertaining to suspicion words.

Automatic versus Controlled Processes

To help explain the unexpected trend that following the smelly fish prime suspicion words were responded to slower than other categories of words, it is worth considering if there may be some inhibition or suppression effects occurring. Previous research has demonstrated that when stimuli are given more attention it results in slower response times (Sekulak & Maciuszek, 2017). This slowing tends to occur when the processing becomes more controlled than automatic (Sassenberg & Moskowitz, 2005). For example, stereotype activation is considered an automatic and unintentional process (i.e., Devine, 1989), however these (stereotypes) can be controlled and overcome with sufficient motivation (i.e., Locke et al., 1994; Moskowitz, 2010; Rudman et al., 2001). This has been demonstrated in research where motivated participants were primed with the image of an African American face were slower to respond to stereotype words (i.e., criminal, athletic) in a lexical decision task than non-motivated participants (Sassenberg & Moskowitz, 2005).

In research more closely aligned with the topic of the current research, Sekulak and Maciuszek (2017) used a lexical decision task to examine what is known as the Macbeth Effect, which relates to the metaphorical association between moral and physical cleanliness, as portrayed by Lady Macbeth's attempts to cleanse her morality/conscious by continually cleaning her hands (i.e., Lee & Schwarz, 2010; Zhong & Liljenquist, 2006). Sekulak and

Maciuszek (2017) predicted and found that after participants were asked to recall a time when they had behaved unethically they were slower to respond to purity/cleanliness words in a lexical decision task (i.e., soap) than non-related words (i.e., chair). They suggest that this is because participants in the unethical condition paid more attention to the cleanliness words, demonstrating a controlled rather than automatic process (Sekulak & Maciuszek, 2017). They contend that "although automatic processes initiate moral decisions, they do not totally dominate them; the judgment may be more effortful and controlled processes" (Haidt, 2007, as cited in Sekulak & Maciuszek, 2017, p. 156). Similar to stereotype activation, the initial process may be automatic but can then switch to a more controlled process. It is plausible that a comparable effect is occurring in the present study whereby participants are paying more attention to suspicion words after being primed with the smelly fish.

Limitations

The findings from the lexical decision task did not provide any clear guidance on which images would best activate the related concepts. The rationale that I developed for the potential for images to prime related concepts was based on conceptually similar previous studies (Park & Hadi, 2020; Rai et al., 2017; Valenzuela & Soriano, 2007). While the current findings were not consistent with the previously demonstrated effects, it is possible that this may have been due to differences in how the priming image was presented. For example, Valenzuela and Soriano (2007) presented their metaphorically related image primes unmasked (i.e., an erupting volcano) within their lexical decision task for 900ms, which is well above the awareness threshold and more than 25 times longer than the duration I used in the current piloting study. Similarly, Park and Hadi (2020) and Rai et al., (2017) allowed participants to view priming images for as long as they liked. Therefore, it may be possible to obtain the desired effects if the images are presented in a supraliminal manner (above the threshold of perception).

Conclusion

The findings from the first stage of pilot testing indicated that images from an observational or object alone perspective would be more effective to use in the second empirical study than images from an egoistic perspective. As such both of these perspectives will be tested for their potential to activate the relevant metaphorical concepts in the next study. Unexpectedly, in the lexical decision task there was trend for suspicion words to be responded to slower than words from other categories, and this was more prominent when primed with a smelly fish. This may indicate that suspicion involves more controlled than automatic processes. While the findings were inconsistent with the previous literature this may have been due to presenting the images in a subliminal manner, rather than giving participants time to view and process the image. Therefore, images will be presented in a manner that will allow this. Specifically, participants will control how long they view the image.

Chapter 7 : Study 2

Previous research has demonstrated that exposure to a fishy smell can increase suspicion related decisions via the conceptual link between fishiness and suspicion in the absence of conscious awareness of the olfactory prime (Lee et al., 2015; Lee & Schwarz, 2012). This effect has been explained as an example of an embodied conceptual metaphor (e.g., Gibbs, 2014). In this case, the metaphor "something smells fishy" is proposed to be the driving influence behind the demonstrated effects.

In Study 1, I replicated and extended research on the fishiness-suspicion embodied conceptual metaphor. Specifically, consistent with previous studies on this topic, I found that participants in the fishy condition invested less tickets in the public goods game and were more likely to use a negative hypothesis test in the Wason Rule Discovery Task, than participants in the other conditions. Furthermore, participants in the fishy condition took longer to complete the experimental tasks than participants in the other conditions. In addition, I investigated the impact of individual difference factors that have been previously shown (thesis study 1) to influence behaviour in these tasks (i.e., trait distrust on public goods game investments) on the fishiness-suspicion embodied conceptual metaphor and found that the embodied effects were sufficiently strong to override the effects of traits.

The current study was designed to test a potential boundary or limit condition of embodied cognition. Specifically, I attempted to cross-modally prime the previously demonstrated, and established, metaphorically consistent link between fishiness and suspicion via a sense other than smell (i.e., vision). Though the findings from the piloting study were inconclusive, potential confounds were identified. By presenting images in a non-subliminal manner I expected that the images would be sufficient to activate the desired associations.

Background to the Current Study

The embodied cognition approach rejects the notion that mental representations consist of arbitrary or amodal symbols (Barsalou, 1999). Instead, representations are locally-

stored fractions of experience (Damasio & Damasio, 1994). For example, if a new smell is encountered, a small fraction of the information is stored or represented within the olfactory area's associative cortex in the brain. A similar process is thought to occur for each of the traditional perceptual senses (taste, smell, vision, touch, audition), as well as for our gestures, actions, and movements (e.g., proprioception; Barsalou, 2008). This leads to a wide variety of modality (e. g., sensory) specific representations that map directly onto the physical interactions with our environment on which they are based. Here engagement of the sensorimotor systems is crucial at all stages of cognitive processing (Harpaintner et al., 2019).

To date, embodied cognition research has yet to explore cross modality priming for the scent modality. Consistent with previous findings, I hypothesised that the fishiness-suspicion link would be primed by images of fish in a manner similar to the direct experience of a "fishy smell" (Lee et al., 2015; Lee & Schwarz, 2012). However, consistent with online cross modality priming, it is expected that the effects will not be as strong as modally direct priming (e.g., Levontin et al., 2015; Slepian et al., 2014).

In addition to the theoretical contribution that cross modal priming of the fishiness concept would provide, it would be a valuable addition to research methodology in this area. Through the use of online participant pools (i.e., TurkPrime, Prolific), online surveys can rapidly gather large sample sizes in a cost efficient manner (Litman et al., 2017). The benefits of online data collection are access to more diverse samples which can lead to more generalisable results. This would be of great benefit to the embodied cognition literature given that, of the nineteen studies included in the meta-analysis (see Chapter 3), only three were conducted outside of the United States, and all of the studies used college student samples which limits the generalisability of the findings (e.g., Simons et al., 2017).

The Current Study

The current study investigated the effects of using visual cues of fishiness, rather than olfactory cues, on the previously demonstrated fishiness-suspicion link (e.g., Lee & Schwarz,

2012). Demonstration of attenuated cross-modality priming of a scent-based metaphor via visual stimuli would provide further support for the multimodal nature of embodied cognition and would provide the necessary evidence to allow the exploration of this metaphor with online samples. Additionally, the current study will attempt to replicate the metaphorical embodied cognition fishiness-suspicion effects that were shown in the first study on the Wason Rule Discovery Task and a public goods game and demonstrate the interaction effects between the embodied cognition effects and individual differences.

As the results of the stimuli piloting study were inconclusive I used two sets of images in a method consistent with my first study (based on previous work; Lee et al., 2015; Lee & Schwarz, 2012). The first set of images were from an observational perspective (i.e., image of a person holding a smelly fish). The second set consisted of images of objects on their own (object alone; i.e., an opened can of fish). I tested the image sets separately using a different sample of participants. Consistent with the pilot study, I used a 2 (smelly, fresh) x 2 (fish, not fish) design was used. However, in this study each participant was only exposed to one category of image (between subjects). The categories were; smelly fish (metaphor consistent image condition), a fresh fish (same concept but not metaphor specific condition), smelly shoes (unpleasant but not metaphor consistent condition), or fresh shoes (neutral condition).

In the current study I replaced the Alternate Uses Task (Wallach & Kogan, 1965), which was used in the first study with the Need for cognition Scale (Cacioppo et al., 1984). This was done because I judged that it would be more relevant to both embodied cognition effects and the experimental tasks used in this study. For example, although not directly linked to the public goods game, research has shown associations between Need for cognition scores and altruism (i.e., prosocial behaviour), and the likelihood to punish unfair behaviour (Siu, 2015). Need for cognition has also been found to be associated with confirmation bias (Kassin et al., 1990), ‘unjustified certainty’ (Kardash & Scholes, 1996), and problem solving (Coutinho, 2006) which may be relevant to performance on the Wason Rule Discovery Task,

and the time taken to complete surveys (Siu, 2015). Furthermore, scores on this scale have been identified as a moderator for metaphor consistent embodied effects (Hauser & Schwarz, 2015). In the first study I tested the direct effects of individual differences on the outcome measures but in the current study I am only focused on the embodied cognition effect, and the interaction between individual differences and embodied cognition.

Based on the results of the first study I predicted that there would be: (a) significantly lower public goods offers and (b) significantly higher use of negative hypothesis tests in the Wason Rule Discovery Task for participants in the smelly fish condition, compared to the other image conditions. I also predicted that people in the smelly fish condition would take significantly longer to complete experimental tasks than people in the other three conditions (indicating higher uncertainty as a result of increased suspicion). Based on the trend shown in the first study, it was also predicted that participants in the smelly fish condition would show greater discrimination in the facial trust measure, such that they would rate trustworthy faces as more trustworthy, and untrustworthy faces as more untrustworthy, than participants in the other conditions. Furthermore, I predicted that there would be significant interactions between embodied cognition effects (image conditions), and individual difference scores on the outcome measures. In contrast to the results of the first study, I predicted that the effect from individual differences will not be overridden by the embodied cognition effects. This will be due to the cross modal weakening of the embodied effects.

Method

Participants

The sample consisted of 358 participants, however, seven were removed for failing to complete any of the outcome measures. A further 35 participants (9.97%) failed the metaphor check and were excluded from analyses. The remaining 316 participants had a mean age of 22.74 years (*SD* = 7.94), and included 266 females (84.17%), 45 males (14.24%), and five that chose not to disclose their gender (1.58%).

All participants were undergraduate students from the Australian Catholic University (Melbourne, Brisbane, Strathfield, and Canberra campuses) who were recruited through the university's SONA recruitment system. The study was conducted entirely online, participants received 0.50% course credit for their participation. All participants were over the age of 18 years of age and were fluent English speakers.

Materials

Demographics Questions. Participants' age, gender, education, nationality, English fluency, and ethnicity were self-reported.

Distrust Scale. Distrust was assessed using the ten items from the International Personality Item Pool (IPIP; Goldberg et al., 2006) Distrust scale. This scale has demonstrated good convergent validity with Cattell's 16 Personality Factor scale of Vigilance (r = .75; Conn & Rieke, 1994). Items were self-descriptive statements (e.g., "I am wary of others") which participants endorsed using a 5-point scale ranging from 1 (*very inaccurate [of me]*) to 5 (*very accurate [of me]*). After reverse scoring four items indicative of trustingness, scores were summed, with a high score indicating high dispositional distrust. The scale demonstrated good internal consistency in the current study ($\alpha = 0.75$).

Intellect Scale. Intellect was assessed using thirteen items from the IPIP (Goldberg et al., 2006) that have demonstrated good convergences with Cattell's 16 Personality Factor scale of Intellect (r = .69; Conn & Rieke, 1994). Each item consisted of a statement (i.e., "I tend to analyse things") and participants were asked to indicate the extent to which the statement described them on a 5-point scale as a description of the participant from 1 (*very inaccurate*) to 5 (*very accurate*). Five items were reverse scored, and then all scores totalled, with a high score indicating high intellect. The scale demonstrated adequate internal consistency in the current study ($\alpha = 0.87$).

Need for Cognition. Need for cognition, the tendency to engage in and enjoy thinking, was assessed using the eighteen items from the Need for cognition scale (Cacioppo

et al., 1984). This scale has previously been shown to be a reliable measure across a broad range of studies and populations, with Cronbach alphas generally over 0.85 (Cacioppo et al., 1996). Each item consisted of a statement (i.e., “I would prefer complex to simple problems”) and participants were asked to indicate the extent to which the statement described them on a 5-point scale as a description of the participant from 1 (*strongly disagree*) to 5 (*strongly agree*). Nine items were reverse scored, and then all scores totalled, with a high score indicating high intellect. This scale demonstrated good internal consistency in the current study ($\alpha = 0.87$)

Image Stimuli. Image stimuli are shown in Figure 7.1. In the first picture (fresh fish condition) the model was holding a fishing rod with a freshly caught fish still on the line. In the second picture (smelly fish condition) the model was holding a smelly fish with rubber gloves and was covering her nose to indicate that it did not smell good. In the third picture (fresh shoes condition) the model was holding new shoes. In the final picture (smelly shoes) of this set the model was holding smelly shoes, again with rubber gloves and covering her nose. The background was then removed from the images, and replaced with a white brick wall, to eliminate any potential confounds. Images were presented in full colour, and 600px (W) x 450px (H) dimensions.

Figure 7.1

Stimuli Used in Observational Perspective Image set

	Fresh	Smelly
Fish		
Shoe		

Each participant only saw a single image (condition), which was presented multiple times. Firstly, participants were asked to take a few moments to memorise the image, and then before each of the outcome measures they were presented again with the same image and asked to select one of the following options; *I am certain this is the same picture I was asked to remember*, *This might be the same the picture I was asked to remember*, or *I am certain this is NOT the same picture I was asked to memorise.* This method was used in order to renew the priming effect prior to each outcome task. Each participant was only presented one type of image to create the experimental conditions.

Public Goods Game. (e.g., modelled after; Berg et al., 1995). Consistent with Lee and Schwarz (2012) the public goods game was used as a measure of social trust. I used a computerised version of the test in which participants were assigned 10 tickets to enter a raffle

to win a $250 voucher for a major Australian retail chain. Participants were told that they could "invest" as many of the 10 tickets as they wished into a communal fund. They were told any tickets they invest into the fund would be doubled, and then the fund would be split evenly between all members of the group. Instructions were presented on screen explaining that the participant would be computer matched with three other participants and a drop-down menu appeared for participants to select the number of tickets they chose to invest. Participants were then informed of the total number of tickets they had accumulated after fund returns.

Wason's Rule Discovery Task (Wason, 1960)**.** This measure compares participants' use of positive hypothesis testing or confirming tests, or negative hypothesis testing (Wason, 1960) when trying to identify the rule governing the generation of a numerical sequence. Participants were presented with a set of three numbers (i.e., 2-4-6) and were told that their task was to figure out the rule that generated the series of numbers presented (e.g., "numbers increase by 2"). After they provided their best guess of the rule, they were given three opportunities to test their hypothesis by entering three sets of three test numbers into the computer (e.g., 4-6-8; 8-10-12; 14-16-18). Previous research has shown that most participants (around 80%; Klayman & Ha, 1989) enter only sets that confirm their rule (positive hypothesis test), rather than sets that disconfirm their rule (negative hypothesis test; e.g. 1-2-3, would test the hypothesis that the rule is "increasing numbers"). After receiving feedback, indicating if each of their sets fit the rule, participants were asked if they wished to change their original guess/rule. Finally, participants were asked if they had seen this task before.

Facial Trust Measure. The facial trust measure assessed participants' perception of the trustworthiness of unfamiliar computer-generated face stimuli with established levels of trustworthiness (Oosterhof & Todorov, 2008). All facial stimuli selected were Caucasian, male, and bald to reduce possible confounding effects (e.g., status and attractiveness). Three facial identities were selected. Each facial identity had 7 variations of trustworthiness (from -3

to +3 *SD* away from the original face on the model's trustworthiness dimension). All participants viewed each of the 21 stimuli once and made a judgement of trustworthiness using a visual analogue scale (-30, Very Untrustworthy to +30, Very Trustworthy). The scale consistency across the faces (21 items) was very good ($\alpha = 0.90$). Participant's scores were then averaged for each valence across the three faces.

I also created two additional variables from the results of this measure. Firstly, I created a 'variation score', to demonstrate the range of ratings provided across the most trustworthy face and the least trustworthy face. This was simply done by calculating the absolute difference in scores between the ratings on each of the two faces. Next, I calculated the line gradient ('gradient score'; *m*) for ratings across all seven face valences. This was calculated using the LINEST function in Excel. Both variable scores were calculated for each individual participant.

Procedure

Participants were recruited for a study investigating individual differences and decision making to be conducted entirely online. Participants first read an information letter for the study, provided consent, and completed the demographic questions. Personality measures were then completed prior to random allocation to the experimental conditions (fresh fish ($n = 77$), smelly fish ($n = 75$), fresh shoes ($n = 82$), or smelly shoes ($n = 82$) where they were presented with the image stimuli to be memorised. Participants then completed the WRDT and the public goods game, the order of which alternated between participants, followed by the facial trust measure. Each participant only saw a single image (condition), which was presented multiple times. Firstly, participants were asked to take a few moments to memorise the image, and then before each of the outcome measures they were presented again with the same image and asked to select one of the following options; *I am certain this is the same picture I was asked to remember*, *This might be the same the picture I was asked to remember*, or *I am certain this is NOT the same picture I was asked to memorise.* This

method was used in order to renew the priming effect prior to each outcome task. Each participant was only presented one type of image to create the experimental conditions. Finally, participants completed a manipulation check that was designed to check whether they were familiar with the metaphor central to the study (i.e., "what does the phrase 'something smells fishy' mean?") before being debriefed and thanked. After data collection was completed the raffle was drawn, and the prize was awarded to the winner.

Results

Descriptive Statistics

Descriptive statistics for the individual difference measures are displayed in Table 7.1 and were found to be similar across experimental conditions. The average Distrust score was close to the scale mid-point, and Intellect and Need for cognition score mean was slightly above the respective scale's mid-point suggesting a slightly above average sample. Separate 2 (fish v shoe) by 2 (smelly v fresh) factorial ANOVAs were conducted for each of the scales presented below, showing that, as expected, no statistically significant differences were found for main effect of object, main effect of smell, or the interaction (all *p*'s > .209).

Table 7.1

Means (Standard Deviations) of Personality Measure Scores as a Function of Condition

Condition		Fresh	Smelly
Fish	Distrust	28.93 (5.29)	28.33 (5.68)
	Intellect	44.23 (5.69)	44.67 (6.78)
	Need for cognition	57.99 (10.44)	56.47 (12.57)
Shoe	Distrust	27.40 (5.74)	27.40 (6.15)
	Intellect	44.15 (5.65)	45.37 (5.77)
	Need for cognition	56.87 (10.80)	58.33 (9.71)

Correlations between all key variables are presented in Table 7.2. Distrust scores were negatively correlated with face trustworthiness ratings across all face valences, indicating as Distrust increased perceptions of trustworthiness consistently decreased. Need for cognition was positively correlated with Intellect scores, and the time taken to complete the survey.

Table 7.2

Pearson Correlations between Variables for Observational Perspective Images

	1	2	3	4	5	6	7	8	9	10	11	12
1. Distrust												
2. Intellect	-0.08											
3. Need for cognition	-0.07	0.55**										
4. Tickets Invested	-0.07	0.08	0.11*									
5. Face A rating	-0.15**	-0.02	0.05	0.04								
6. Face B rating	-0.15**	0.04	0.06	0.05	0.81**							
7. Face C rating	-0.16**	0.02	0.05	-0.09	0.70**	0.71**						
8. Face D rating	-0.18**	0.08	0.11*	-0.09	0.50**	0.51**	0.58**					
9. Face E rating	-0.22**	0.05	0.06	-0.09	0.25**	0.34**	0.47**	0.59**				
10. Face F rating	-0.20**	0.05	0.04	-0.08	0.07	0.14**	0.35**	0.60**	0.71**			
11. Face G rating	-0.16**	0.10	0.08	-0.08	-0.01	0.14**	0.28**	0.45**	0.65**	0.75**		
12. Duration	-0.08	0.14**	0.08	0.02	-0.02	-0.03	-0.03	-0.01	-0.03	0.00	0.01	
13. Used Negative Test	-0.01	0.01	0.13*	0.03	0.12*	0.06	0.09	0.06	0.01	0.03	0.01	0.03

Note: * $p < .05$, ** $p < .001$, Spearman Correlations conducted with Used Negative Test.

For the Public Goods Game, participants in the Fresh Fish condition invested the least amount of tickets (*M* = 5.84, *SD* = 2.69), followed by those in the Fresh Shoes condition (*M* = 5.99, *SD* = 2.78), Smelly Shoes (*M* = 6.15, *SD* = 2.89), and Smelly Fish (*M* = 6.41, *SD* = 3.15) conditions. A 2 (fish v shoe) by 2 (smelly v fresh) factorial analysis of variance (ANOVA) was conducted to compare the number of tickets invested across conditions showed that there was no main effect of object $F(1, 312) = 0.01$, $p = .913$, or main effect of Smell $F(1,312) = 2.00$, $p = .158$, There was also no significant interaction effect $F(1, 312) = 0.11$, $p = .742$.

To examine the potential interaction effect of embodied cognition effects and personality on the number of tickets invested, separate correlations were conducted for each condition. As shown in Table 7.3. Need for cognition was positively correlated with the number of tickets invested in the public goods game, but only for the shoe conditions.

Table 7.3

Means (Standard Deviations) of Personality Measure Scores separated by Condition

Condition	*n*	Personality Measure	*r*	*p*
Fresh Fish	77	Distrust	-0.06	.600
		Intellect	-0.05	.673
		Need for cognition	-0.02	.896
Smelly Fish	75	Distrust	0.02	.856
		Intellect	<-0.01	.989
		Need for cognition	0.08	.517
Fresh Shoes	82	Distrust	-0.19	.087
		Intellect	0.15	.176
		Need for cognition	0.23*	.038
Smelly Shoes	82	Distrust	0.18	.116
		Intellect	-0.07	.559
		Need for cognition	0.22*	.043

Wason Rule Discovery Task

I expected that those in the smelly fish condition would be more likely to avoid confirmatory bias, as indicated by the use of at least one negative hypothesis test, compared to those in the other conditions. In the smelly fish condition 19 of the 75 participants (25.33%) used a negative hypotheses test. However, 21 out of 81 participants (25.93%) in the fresh shoes condition also used a negative hypotheses test. In the Fresh Fish condition 11 out of 77 participants (14.28%) used a negative hypotheses test. Finally, in the smelly shoes condition 19 out of 82 (23.18%) used a negative hypotheses test. A 2 X 2 chi-square test of independence of the number of participants in each condition to use a negative hypothesis test revealed no significant difference between groups, $\chi^2(1, N= 351) = 1.73$, $p = .188$.

To examine the potential interaction between embodied cognition effects and personality separate independent t-tests were conducted for each condition. Results are shown in Table 7.4. There were no statistically significant differences between participants that used a negative hypothesis test, and those that did not, on any personality measure within any condition. Though there were noticeable differences in the expected direction for some of the Need for cognition scores between participants that used a negative hypothesis test, and those that did not, these differences were not statistically significant (smelly fish, $p = .082$; fresh shoes, $p = .059$).

Table 7.4

Difference in Personality Scores for Each Condition for the WRDT

			Used Negative Test		
Condition	*n*	Personality Measure	Yes	No	M_{diff}
Fresh Fish	77	Distrust	28.09 (5.03)	29.00 (5.45)	0.91
		Intellect	42.91 (5.80)	44.97 (5.78)	2.06
		Need for cognition	59.27 (7.88)	58.12 (10.58)	1.15
Smelly Fish	75	Distrust	28.74 (6.41)	28.20 (5.61)	0.50
		Intellect	43.63 (8.45)	45.32 (6.33)	1.69
		Need for cognition	61.58 (12.82)	55.68 (12.56)	5.90
Fresh Shoes	81	Distrust	27.29 (6.69)	27.00 (5.65)	0.29
		Intellect	46.57 (6.14)	43.88 (5.33)	2.69
		Need for cognition	61.19 (9.64)	55.87 (11.39)	5.32
Smelly Shoes	82	Distrust	26.95 (5.95)	27.59 (6.29)	0.64
		Intellect	46.37 (5.90)	45.57 (5.84)	0.80
		Need for cognition	59.68 (13.07)	58.35 (8.66)	1.33

Time Taken

In order to analyse effects on the time taken to complete the survey, some data cleaning was first necessary. Though the overall mean duration was 44.09 minutes, this was heavily affected by some participants completing the study over a number of days. As more than 92% of participants completed the study quicker than the overall mean. I first removed participants that took longer than 10,000 seconds (6 participants; 2 hours 46 minutes), and then recalculated the mean (1384.99 seconds) and standard deviation (869.86), and then Winsorized the remaining data by replacing outlier scores with the mean + 3.29 *SD* (9 scores) with the value of 4246.83 seconds (Ratcliff, 1993; Sheskin, 2004). It was predicted that those

in the smelly fish condition would take longer to complete the study than those in the other conditions. A 2(fish v shoe) by 2(smelly v fresh) factorial ANOVA was conducted to compare the variation score across conditions showed that there was no main effect of Object F (1, 305) = 0.19, p = .661, and no main effect of Smell F (1,305) = 0.96, p = .328. However, there was a significant interaction effect F (1, 305) = 4.316, p = .039, partial η^2 = .014. However, this was not in the expected direction with participants in the Fresh shoe condition taking the longest to complete the survey (M = 1516.10, SD = 946.12), followed by the participants in the smelly fish condition (M = 1400.79, SD = 733.26), then fresh fish (M = 1311.66, SD = 594.09). The participants in the smelly shoes condition were fastest in completing the survey (M = 1267.58, SD = 492.70).

To examine the potential interaction between personality measures and embodied cognition effects on the time taken to complete the study I conducted separate correlations (Bonferroni corrected) for each condition. As seen in Table 7.5. in the fresh fish condition only the Need for cognition was positively correlated with the time taken to complete the survey. In the smelly fish condition only the Intellect scores were positively correlated with the time taken to complete the survey. In the smelly shoes condition only the Distrust scores were positively correlated with the time taken to complete the survey.

Table 7.5

Correlations between Personality Measures and Duration for Each Condition

Condition	*n*	Personality Measure	*r*	*p*
Fresh Fish	76	Distrust	-0.06	0.611
		Intellect	0.17	0.150
		Need for cognition	0.25	0.031
Smelly Fish	71	Distrust	-0.05	0.703
		Intellect	0.27	0.025
		Need for cognition	0.02	0.880
Fresh Shoes	81	Distrust	-0.06	0.616
		Intellect	0.03	0.796
		Need for cognition	-0.03	0.806
Smelly Shoes	81	Distrust	0.26	0.021
		Intellect	-0.18	0.107
		Need for cognition	0.20	0.078

Facial Trust Measure

It was predicted that participants in the fishy smell condition would rate trustworthy faces as more trustworthy than participants in the other conditions, and that they would rate untrustworthy faces as more untrustworthy than participants in the other conditions. Mean scores were calculated by first averaging participant responses across the three faces presented for each trustworthiness valence, and then averaging across participants. As shown in Table 7.6, for the most trustworthy face (Face G; +3 Valence), participants in the Smelly Fish condition rated this as more trustworthy, than participants in the other conditions did. Furthermore, for the most untrustworthy face (Face A; -3 Valence) participants in the Smelly Fish condition rated this face as more untrustworthy than participants in the other conditions.

To test this further I used the variance score which represents the absolute difference between ratings on the most untrustworthy and most trustworthy faces. The variance score was largest for the smelly fish condition (*M* = 19.80, *SD* = 13.83), followed by the fresh fish condition (*M* = 16.04, *SD* = 9.19), then the fresh shoes condition (*M* = 15.15, *SD* = 10.21), and smallest for the smelly shoes condition (*M* = 14.90, *SD* = 11.99).

Table 7.6

Means (Standard Deviations) of Facial Trustworthiness Ratings by Condition

	Condition			
	Fresh Fish (*n* = 77)	Smelly Fish (*n* = 75)	Fresh Shoes (*n* = 82)	Smelly Shoes (*n* = 82)
Face A rating	-9.64 (9.74)	-12.19 (10.06)	-11.85 (9.67)	-9.87 (11.18)
Face B rating	-5.75 (8.90)	-9.03 (8.17)	-8.86 (8.85)	-7.67 (9.5)
Face C rating	-3.44 (8.23)	-5.05 (7.36)	-5.91 (8.57)	-3.55 (8.57)
Face D rating	0.98 (7.55)	-1.73 (7.68)	-1.85 (8.55)	-0.51 (6.89)
Face E rating	3.57 (6.49)	2.72 (7.54)	1.15 (8.84)	2.04 (6.38)
Face F rating	7.37 (6.95)	5.93 (7.54)	3.45 (9.6)	5.42 (7.03)
Face G rating	7.29 (7.67)	7.97 (8.49)	4.17 (8.86)	6.32 (7.12)

A 2 (fish versus shoe) by 2 (smelly versus fresh) factorial ANOVA was conducted to compare the variance score across conditions showed that there was a significant main effect of fish $F(1, 312) = 4.50$, $p = .035$, partial $\eta^2 = .014$, With fish responses showing larger variance (*M* = 17.89, *SD* = 11.83) than shoes responses (i.e., Shoes; *M* = 15.03, *SD* = 11.10), $t(314) = 2.22$, $p = .027$. There was no main effect of smelly $F(1,312) = 1.90$, $p = .170$, There was also no significant interaction effect, $F(1, 312) = 2.51$, $p = .114$.

To examine how the effect of personality varied across conditions separate correlations were conducted for each condition. The results are presented in Table 7.7. below.

In the fresh fish condition only the Distrust scores were positively correlated with the variation score. There were no other significant correlations between any of the personality measures and variation scores in the other conditions.

Table 7.7

Correlations between Personality Measures and Variation scores for Each Condition

Condition	*n*	Personality Measure	*r*	*p*
Fresh Fish	77	Distrust	.241	0.035
		Intellect	-0.09	0.423
		Need for cognition	-0.05	0.647
Smelly Fish	75	Distrust	0.02	0.832
		Intellect	0.07	0.563
		Need for cognition	0.06	0.604
Fresh Shoes	82	Distrust	-0.16	0.154
		Intellect	0.16	0.151
		Need for cognition	0.00	0.978
Smelly Shoes	82	Distrust	0.11	0.309
		Intellect	0.08	0.505
		Need for cognition	-0.06	0.564

Interim Discussion

First, it was predicted that there would be significantly lower public goods offers and significantly higher use of negative hypothesis tests on the Wason Rule Discovery Task for participants in the smelly fish condition, compared to the other image conditions. Neither of these hypotheses were supported. Next, it was predicted that people in the smelly fish condition would take significantly longer to complete experimental tasks than people in the other three conditions (indicating higher uncertainty as a result of increased suspicion). This

hypothesis was also not supported. Based on the trend shown in the first study, it was also predicted that participants in the smelly fish condition would show greater discrimination in the facial trust measure, such that they would rate trustworthy faces as more trustworthy, and untrustworthy faces as more untrustworthy, than participants in the other conditions. Though the results were in the predicted direction, and there was a main effect of Fish, there was no main effect of Smelly, and therefore this hypothesis was also not supported.

Finally, I predicted that there would be significant interactions between embodied cognition effects (image conditions), and individual difference scores on the outcome measures. This hypothesis was also not supported as there was no significant pattern of effects of the image conditions, or effects of individual difference scores on any of the outcome measures used.

These findings suggest that images from the observational perspective were not sufficient to prime the expected metaphor consistent effects, with no consistent or discernible pattern of findings using this image set.

I then proceeded to test the object alone set of images using the same methodology as described above but replaced the observational perspective images with images of the objects on their own. The hypotheses were also the same. Specifically, I predicted that there would be: (a) significantly lower public goods offers and (b) significantly higher use of negative hypothesis tests in the Wason Rule Discovery Task for participants in the smelly fish condition, compared to the other image conditions. I also predicted that people in the smelly fish condition would take significantly longer to complete experimental tasks than people in the other three conditions (indicating higher uncertainty as a result of increased suspicion). It was also predicted that participants in the smelly fish condition would show greater discrimination in the facial trust measure, such that they would rate trustworthy faces as more trustworthy, and untrustworthy faces as more untrustworthy, than participants in the other conditions. Finally, I again predicted that there would be significant interactions between

embodied cognition effects (image conditions), and individual difference scores on the outcome measures.

Method

Participants

The sample consisted of 147 participants, however, 13 participants (8.84%) failed the metaphor check and were excluded from further analyses. The remaining 134 participants had a mean age of 23.80 years (*SD* = 8.40), and included 113 females (84.33%), 20 males (14.93%), and one participant that chose not to disclose their gender (0.75%).

All participants were undergraduate students from the Australian Catholic University (Melbourne, Brisbane, Strathfield, and Canberra campuses) who were recruited through the university's SONA recruitment system. The study was conducted entirely online, participants received 0.50% course credit for their participation. All participants were over the age of 18 years of age and fluent English speakers.

Materials

Demographic and personality measures were the same as used when testing the observational perspective image set. Reliabilities for the personality measures were as follows; IPIP Distrust ($\alpha = 0.82$), IPIP Intellect ($\alpha = 0.75$), and Need for cognition ($\alpha = 0.89$).. The facial trust measure demonstrated good internal consistency $\alpha = 0.86$.

Image Stimuli. Image stimuli are shown in Figure 8.2. For the object alone image set a wide variety of condition relevant images (free stock) were collated from various internet sources. These images were then piloted to determine the most suitable. As shown in Figure 7.2. these images were selected to convey the same concepts as those used in the observational perspective image set. These were; fresh fish, smelly fish, fresh shoes, and smelly shoes. Images were presented in full colour, and 600px (W) x 450px (H) dimensions.

Figure 7.2

Stimuli Used in the Object Alone Image set

	Fresh	Smelly
Fish		
Shoe		

Procedure

The procedure used for the testing of the object alone image set was exactly the same as that used for the observational perspective image set. only the image stimuli set was replaced. Random allocation to the experimental conditions was completed by Qualtrics; fresh fish (n = 26), smelly fish (n = 37), fresh shoes (n = 31), or smelly shoes (n = 40).

Results

Descriptive Statistics

Descriptive statistics for the individual difference measures are displayed in Table 7.8 and were found to be similar across experimental conditions. The average Distrust score was close to the scale mid-point, and Intellect and Need for cognition score mean was slightly

above the respective scale's mid-point suggesting a slightly above average sample. Separate 2 (fish v shoe) by 2 (smelly v fresh) factorial ANOVAs were conducted for each of the scales presented below, showing that, as expected, no statistically significant differences were found for main effect of object, main effect of smell, or the interaction (all *p*'s > .08).

Table 7.8

Means (Standard Deviations) of Personality Measure Scores as a Function of Condition

Condition		Fresh	Smelly
Fish	Distrust	28.27 (6.17)	27.59 (5.67)
	Intellect	44.69 (7.15)	43.95 (6.31)
	Need for cognition	60.95 (10.72)	57.51 (12.37)
Shoe	Distrust	26.52 (7.56)	29.90 (6.44)
	Intellect	46.58 (7.68)	45.70 (5.96)
	Need for cognition	64.00 (11.34)	58.25 (11.79)

Correlations between all key variables are presented in Table 7.9. Need for cognition was positively correlated with Intellect scores ($p < .001$). There were also correlations across different valences of the facial trust measure, indicating some internal consistency of the measure.

Table 7.9

Pearson Correlations between Key Variables in Part B

	1	2	3	4	5	6	7	8	9	10	11	12
1. Distrust												
2. Intellect	-0.09											
3. Need for cognition	-0.12	0.57**										
4. Tickets Invested	-0.10	-0.10	0.02									
5. Face A rating	-0.03	0.10	0.14	-0.15								
6. Face B rating	-0.09	0.14	0.14	-0.10	0.78**							
7. Face C rating	-0.04	0.76	0.17	-0.09	0.61**	0.68**						
8. Face D rating	-0.20*	0.03	0.10	0.12	0.22*	0.38**	0.51**					
9. Face E rating	-0.17	0.03	0.06	0.09	0.07	0.16	0.37**	0.60**				
10. Face F rating	-0.18*	-0.14	-0.07	0.10	-0.09	0.04	0.20*	0.41**	0.58**			
11. Face G rating	-0.20*	-0.08	-0.12	0.15	-0.07	0.01	0.12	0.39**	0.57**	0.74**		
12. Duration	-0.08	0.14	0.08	0.22*	0.03	0.02	0.05	0.06	0.02	-0.06	-0.13	
13. Used Negative Test	-0.09	-0.11	0.07	0.13	0.03	-0.04	0.11	0.05	0.19*	0.11	0.15	-0.03

Note: * $p < .05$, ** $p < .001$, Spearman Correlations for Used Negative Test

Public Goods Game

For the Public Goods Game, participants in the smelly shoes condition invested the least amount of tickets ($M = 5.65$, $SD = 2.59$), followed by those in the fresh fish condition ($M = 5.92$, $SD = 2.92$), smelly fish ($M = 5.95$, $SD = 3.37$), and fresh shoes ($M = 6.03$, $SD = 2.83$) conditions. A 2 (fish v shoe) by 2 (smelly v fresh) factorial ANOVA was conducted to compare the number of tickets invested across conditions showed that there was no main effect of Fish $F(1, 130) = 0.03$, $p = .856$, or main effect of Smelly $F(1, 130) = 0.12$, $p = .728$, There was also no significant interaction effect $F(1, 130) = 0.16$, $p = .695$.

To examine the potential interaction effect of embodied cognition effects and personality on the number of tickets invested, separate correlations were conducted for each

condition. As shown in Table 7.10. Distrust was negatively correlated with the number of tickets invested in the public goods game, but only for the smelly shoe condition.

Table 7.10

Means (Standard Deviations) of Personality Measure Scores as a Function of Condition

Condition	*n*	Personality Measure	*r*	*p*
Fresh Fish	26	Distrust	-0.08	.695
		Intellect	0.19	.352
		Need for cognition	-0.01	.969
Smelly Fish	37	Distrust	0.05	.763
		Intellect	-0.19	.264
		Need for cognition	0.10	.571
Fresh Shoes	31	Distrust	0.03	.885
		Intellect	-0.30	.109
		Need for cognition	-0.04	.829
Smelly Shoes	40	Distrust	-0.38*	.017
		Intellect	-0.04	.805
		Need for cognition	-0.02	.904

Wason Rule Discovery Task

I expected that those in the smelly fish condition would be more likely to avoid confirmatory bias, as indicated by the use of at least one negative hypothesis test, compared to those in the other conditions. In the smelly fish condition eight of the 37 participants (21.62%) used a negative hypotheses test. However, seven out of 31 participants (22.58%) in the fresh shoes condition also used a negative hypotheses test. In the fresh fish condition four out of 26 participants (15.38%) used a negative hypotheses test. Finally, in the smelly shoes condition six out of 39 (15.38%) used a negative hypotheses test. A 2 X 2 chi-square test of

independence of the number of participants in each condition to use a negative hypothesis test revealed no significant difference between groups, $\chi^2(1, N= 133)) = 1.07$, $p = .302$.

To examine the potential interaction between embodied cognition effects and personality separate independent *t*-tests were conducted for each condition. Results are shown in Table 7.11. There were no statistically significant differences between participants that used a negative hypothesis test, and those that did not, on any personality measure within any condition (all *p*s > .18).

Table 7.11

Difference in Personality Scores for each Condition for the Wason Rule Discovery Task

			Used Negative Test		
Condition	*n*	Personality Measure	Yes	No	*M*diff
Fresh Fish	26	Distrust	26.75 (8.96)	26.18 (5.82)	0.57
		Intellect	44.25 (7.46)	44.77 (7.27)	0.52
		Need for cognition	58.00 (5.48)	61.36 (11.43)	3.36
Smelly Fish	37	Distrust	27.38 (6.41)	27.66 (5.92)	0.28
		Intellect	41.87 (5.99)	44.52 (6.38)	2.65
		Need for cognition	62.50 (12.82)	56.14 (12.53)	6.36
Fresh Shoes	31	Distrust	25.86 (6.54)	26.71 (7.95)	0.85
		Intellect	44.00 (5.54)	47.33 (8.14)	3.73
		Need for cognition	61.86 (10.12)	64.62 (11.79)	2.76
Smelly Shoes	39	Distrust	25.50 (7.71)	30.64 (6.08)	5.14
		Intellect	45.83 (3.87)	45.58 (6.37)	0.25
		Need for cognition	64.33 (11.00)	57.39 (11.87)	6.94

Time Taken

In order to analyse effects on the time taken to complete the survey, some data cleaning was first necessary. Though the overall mean duration was 147.13 minutes, this was heavily affected by some participants completing the study over a number of days. As more than 93% of participants completed the study quicker than the overall mean. I first removed participants that took longer than 10,000 seconds (9 participants; 2 hours 46 minutes), and then recalculated the mean (M = 1278.00 seconds) and standard deviation (SD = 506.72), There were no participants who took longer than the mean +3.29 SD (2945.11 seconds). It was predicted that those in the smelly fish condition would take longer to complete the study than those in the other conditions. Participants in the smelly fish condition took the longest time to complete the survey (M = 1432.11 , SD = 604.11), followed by the participants in the fresh shoes condition (M = 1303.69, SD = 342.35), then smelly shoes (M = 1211.54, SD = 553.20). The participants in the fresh fish condition were fastest in completing the survey (M = 1198.72, SD = 425.68). A 2 (fish v shoe) by 2 (smelly v fresh) factorial ANOVA was conducted to compare the variance scores across conditions showed that there was no main effect of Object F (1, 121) = 0.39, p = .534, and no main effect of Smell F (1, 121) = 0.58, p = .448. There was also no significant interaction effect F (1, 121) = 3.085, p = .082,

To examine the potential interaction between personality measures and embodied cognition effects on the time taken to complete the study I conducted separate correlations for each condition. As seen in Table 7.12. in the smelly fish condition only the Intellect scores were positively correlated with the time taken to complete the survey. There were no other statistically significant correlations.

Table 7.12

Correlations between Personality Measures and Duration for Each Condition

Condition	*n*	Personality Measure	*r*	*p*
Fresh Fish	25	Distrust	-0.13	0.540
		Intellect	0.29	0.165
		Need for cognition	0.23	0.266
Smelly Fish	35	Distrust	0.18	0.292
		Intellect	0.37*	0.027
		Need for cognition	0.33	0.060
Fresh Shoes	26	Distrust	0.04	0.835
		Intellect	0.10	0.646
		Need for cognition	0.06	0.779
Smelly Shoes	39	Distrust	-0.06	0.701
		Intellect	-0.08	0.631
		Need for cognition	-0.19	0.241

Facial Trust Measure

It was predicted that participants in the smelly fish condition would rate trustworthy faces as more trustworthy than participants in the other conditions, and that they would rate untrustworthy faces as more untrustworthy than participants in the other conditions. As shown in Table 7.13, for the most trustworthy face (Face G; +3 Valence), participants in the smelly fish condition did not rate this as more trustworthy than participants in the smelly shoes conditions did. For the most untrustworthy face (Face A; -3 Valence) participants in the smelly fish condition rated this face as more untrustworthy than participants in the other conditions. To test this further I used the variance score which represents the absolute difference between ratings on the most untrustworthy and most trustworthy faces. The

variance score was largest for the smelly fish condition (M = 19.02, SD = 10.50), followed by the fresh fish condition (M = 18.33, SD = 10.21), then the smelly shoes condition (M = 18.09, SD = 8.82), and smallest for the fresh shoes condition (M = 14.94, SD = 11.48).

Table 7.13

Means (Standard Deviations) of Facial Trustworthiness Ratings by Condition

	Condition			
	Fresh Fish (n = 26)	Smelly Fish (n = 37)	Fresh Shoes (n = 31)	Smelly Shoes (n = 40)
Face A rating	-8.85 (9.23)	-12.70 (9.45)	-9.88 (8.49)	-12.06 (7.94)
Face B rating	-5.96 (7.96)	-10.48 (8.45)	-6.04 (6.63)	-7.98 (8.13)
Face C rating	-0.90 (6.14)	-4.45 (8.33)	-3.05 (5.77)	-3.67 (7.49)
Face D rating	3.85 (5.16)	-1.59 (7.19)	-1.15 (5.32)	-0.91 (6.29)
Face E rating	7.36 (5.94)	4.43 (7.04)	2.94 (4.96)	3.37 (6.56)
Face F rating	10.77 (6.08)	6.51 (8.60)	6.41 (6.35)	6.38 (8.06)
Face G rating	10.95 (7.73)	7.88 (8.23)	5.74 (6.79)	7.98 (7.68)

A 2 (fish versus shoe) by 2 (smelly versus fresh) factorial ANOVA was conducted to compare the variation score across conditions showed that there was no significant main effect of Fish $F(1, 130) = 1.46$, $p = .229$. There was no main effect of Smelly $F(1, 130) = 1.15$ $p = .285$. There was also no significant interaction effect, $F(1, 130) = 0.48$, $p = .491$.

To examine how the effect of personality varied across conditions separate correlations were conducted for each condition. The results are presented in Table 7.14. below. In the smelly shoes condition only the Distrust scores were negatively correlated with the variation score. There were no other significant correlations between any of the personality measures and variation scores in the other conditions.

Table 7.14

Correlations between Personality Measures and Variation scores for Each Condition

Condition	*n*	Personality Measure	*r*	*p*
Fresh Fish	26	Distrust	0.06	0.776
		Intellect	-0.04	0.844
		Need for cognition	-0.23	0.265
Smelly Fish	37	Distrust	0.05	0.755
		Intellect	-0.16	0.340
		Need for cognition	-0.32	0.053
Fresh Shoes	31	Distrust	0.15	0.428
		Intellect	-0.28	0.129
		Need for cognition	0.00	0.985
Smelly Shoes	40	Distrust	-0.39*	0.013
		Intellect	0.06	0.717
		Need for cognition	0.00	0.987

Discussion

The main aim of this study was to investigate the effects of using visual cues of fishiness, rather than olfactory cues, on the previously demonstrated fishiness-suspicion link (e.g., Lee & Schwarz, 2012). Broadly speaking, the findings indicate that the visual stimuli did not have the same impact as the olfactory-based prime on the fishiness-suspicion link. Specifically, the predictions that participants who were asked to memorise a smelly fish image would (a) make significantly lower public goods offers, (b) be significantly more likely to use negative hypothesis tests in the Wason Rule Discovery Task, and (c) take significantly longer to complete the tasks, compared to the other image conditions were not supported. These results were consistent across both observational and object alone image sets.

It was also predicted that participants who memorised the smelly fish image would show greater discrimination in the facial trust measure. While the mean variation scores in trustworthiness ratings were highest in the smelly fish condition, there was no statistically significant difference between conditions. Though the results showed a trend in the predicted direction, there was no statistically significant difference between groups, and therefore this hypothesis was also not supported. Finally, the predicted weakening of embodied cognition effects (image conditions) due to cross-modal priming, compared to individual difference scores, on the outcome measures was not found in this study. In contrast to the results of the first study I predicted that the effect from individual differences will not be overridden by the embodied cognition effects, due to the cross modal weakening of the embodied effects. This hypothesis was also not supported by the results of this study, as there were no consistent embodied effects.

The findings from this study were not consistent with the previous research (Lee et al., 2015; Lee & Schwarz, 2012), or the results from the first empirical study in this thesis. This suggests that the fishiness-suspicion link which is grounded in the sensory modality of olfaction, was not replicated by visual primes. This is somewhat surprising given previous research that has used visual images to cross-modally prime a metaphor consistent embodied effect (Levontin et al., 2015; Park & Hadi, 2020; Rai et al., 2017; Shalev, 2014, 2016). However, no previous research has been conducted on specifically priming a scent related metaphor via a modality other than olfaction. Scent is considered to be a primal and deeply rooted sense that is fundamental to survival (Zaltman, 2003), and the oldest and most direct of the senses (Kitson & McHugh, 2019) and it might be that scent related metaphors are less prone to cross-modal activation. Based on the literature reviewed I expect that some cross activation of relevant neural areas is occurring (i.e., González et al., 2006; Hauk et al., 2004), via the presented stimuli, but not at a sufficient strength to activate the fishiness-suspicion link.

Though not directly specific to embodied cognition research a key strength of this study is the continued trend or pattern in the perceptions of facial trustworthiness shown here and in Study 1. It would appear that the effects of suspicion are distinct from the effects of distrust, providing evidence for the need to separate these constructs, which are often considered as essentially similar (Griffiths, 2014; Kramer, 1998). Increasing distrust and suspicion leads to the rating of untrustworthy faces as more untrustworthy, however while increasing distrust appears to have a consistent lowering of ratings across all valences of faces, suspicion appears to make responses more extreme, with increasing suspicion leading to untrustworthy faces being judged as more untrustworthy, as expected, but also leading to trustworthy faces being judged as more trustworthy.

There is limited research exploring this distinction between distrust and suspicion concepts, however Sinaceur (2009) suggests that there is an important distinction to be made between these concepts. Sinaceur argues that distrust is implicated in automatic decision making, while suspicion affects level of uncertainty, and generates further search for information. This may account for the inconsistency between the current results and those of the first empirical study. Specifically, participants in the smelly fish condition were more likely to avoid confirmation bias than other participants, yet there was no relationship between trait distrust and behaviour in the Wason Rule Discovery Task.

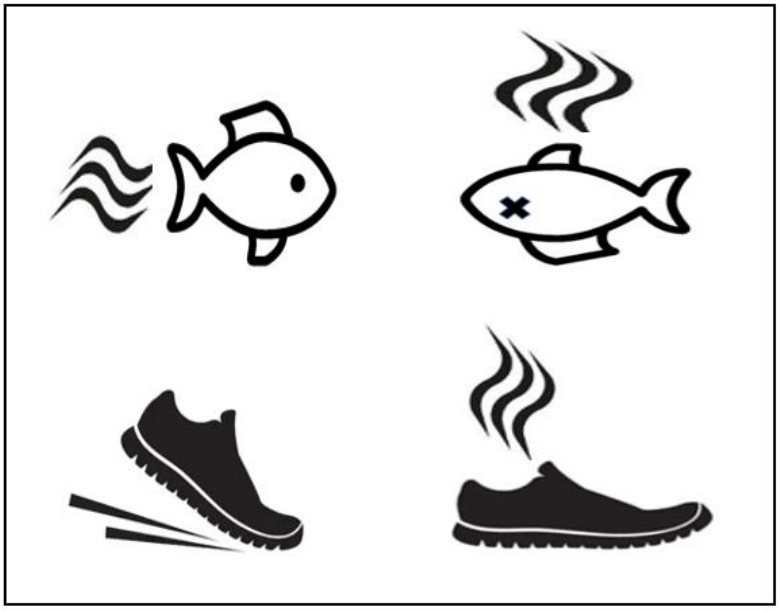
Limitations and Future Research

Firstly, it must be noted that it is conceivable that ideal images may elicit the metaphor consistent embodied effects, but that the images used in this study were not ideal. The piloting of stimuli was based on previous research, but far from exhaustive, as there are no clear guidelines on the approach to be used in stimuli selection or testing (e.g., no criteria for identifying an appropriate image). The development of a protocol and criteria for assessing cross modal – especially visual stimuli – would be of significant benefit to this research. On the basis of such guidelines, further testing of a wider variety of images may be useful.

One factor not considered in the current study was picture complexity. Previous research in cross-modal priming has used simplified images, such as stick figures (Winter & Matlock, 2013), or simple line drawings (Slepian et al., 2014). It may be worth piloting simplified images such as that shown in Figure 7.3. below. It may also be beneficial to include images specifically created/commissioned by a graphics designer, or photographer, to best capture/portray the relevant concept.

Figure 7.3

Example of Simplified Images of Conditions for Future Piloting



Aside from the images themselves, there may also be changes to the methodology that may increase the potential for cross-modal activation. For example, after presenting participants with multiple (six) images of people feeling warm or cold, Rai et al., (2017) then asked participants to recall and write about an incident that they themselves had experienced being warm/cold in the past. Furthermore, Shalev (2014; 2016), asked participants to imagine themselves in the places that presented images depicted, and specifically requested a multimodal imagining (i.e., colours, textures, sounds, and smells), based on previous methodology shown to increase immersion (Weinstein et al., 2009). Increasing the

participant's immersion in the experiences depicted may potentially increase the strength of the cross-modal activation.

Conclusion

The main aim of this study was to investigate the effects of using visual cues of fishiness, rather than olfactory cues, on the previously demonstrated fishiness-suspicion link (Lee & Schwarz, 2012). Based on the obtained findings this does not appear likely, however further research is required to further test this by using different images (i.e., simplified sketches), and a more immersive procedure (i.e., asking participants to imagine themselves experiencing the depicted scenario). While images have previously been used successfully to cross-modally prime temperature related metaphor consistent effects (i.e., warm images and social connectedness; Rai et al., 2017) it may be that scent related metaphors are more difficult to prime across modalities due to smell being a more primal and direct sense (Kitson & McHugh, 2019).

Chapter 8 : General Discussion

The central aim of this thesis was to replicate and extend research on the fishiness-suspicion metaphor (Lee et al., 2015; Lee & Schwarz, 2012) by exploring the boundaries and limitations of this effect. In so doing, I contributed to the evidence for embodied cognition generally, and conceptual metaphor theory (i.e., Lakoff, 2012) more specifically. Using a rigorous and systematic approach I addressed this aim across three studies. Firstly, I conducted a meta-analysis of the available empirical evidence involving gustatory sense-based metaphor consistent embodied cognition effects in order to determine the strength and consistency of these effects. Secondly, I replicated previous research that demonstrated the embodied effects of a fishy smell on social decision making (Lee & Schwarz, 2012), and cognitive processes (Lee et al., 2015) to test that this specific effect would be present in an independent sample. I extended this research by also integrating personality variables to examine potential dispositional boundaries that may interact with the observed metaphor consistent embodied effects. In the final study I tested whether these effects could be induced via visual stimuli rather than the presence of a smell (cross modal priming), in order to examine whether this particular effect is modality specific.

In this chapter I will firstly provide a brief summary of the findings for each of the empirical chapters presented in this thesis, and then discuss the particular limitations of these results. After discussing the implications of the research presented, I will suggest areas for future research and the next steps that can be taken to further explain and understand embodied cognition and conceptual metaphor theory.

Overview of the Meta-Analysis

To address the aim of this thesis which was to explore the boundaries and limitations of embodied cognition and conceptual metaphor theory, I identified the lack of broader review and synthesis of the available findings. While I acknowledged that this may be due to the relative newness of the field, there was a clear need for a cohesive and agreed upon

theoretical framework in this literature. Therefore, my first step was to conduct a meta-analysis of the relevant findings to determine the strength and consistency of metaphor consistent embodied effects involving the gustatory senses. I note that this is of particular importance given the ongoing debate concerning the reliability of metaphor consistent embodied effects and related issues arising from the "replication crisis" (Borghi & Fini, 2019; Harris et al., 2013). The secondary aim of conducting the meta-analysis was to inform the design of the planned empirical studies within the current thesis.

The results of the meta-analysis, which included 19 studies (N = 1334), indicated that gustatory metaphor consistent embodied effects are consistent (i.e., low variability), and typically demonstrate moderate to large effect sizes in the predicted (i.e., metaphor consistent) direction. This suggests that the published effects are present and reliably stable (Shercliffe et al., 2009). In addition, evidence from a broad range of bias tests (e.g., *p*-curve test, *p*-uniform test, funnel plots), suggests that these effects are generally robust to publication bias. Though the reliability of primed effects in this domain is currently under debate (Harris et al., 2013), the evidence for the studies included in this meta-analysis provides clear evidence for the presence of metaphor consistent embodied cognition effect of a moderate to large size, and was sufficient to warrant continued research on embodied conceptual metaphors within the current thesis.

Separate analyses were conducted for studies with a control condition, and studies with a comparator condition. Effect size estimates for the comparison of the target manipulation vs a control or a comparator condition were similar. This seems to indicate that either type of comparison group would be sufficient on its own. However, it is important to bear in mind that studies are better off including both an empty control and a conceptual control, as this provides more rigor, adding conceptual strength and further depth to the findings. For example, metaphors of sweetness are related to being kind, gentle, and friendly (Ahn & Min, 2020), which is consistent with previous research that has demonstrated that the

physical experience of a sweet taste is linked to positive judgments and evaluations (e.g., Miska et al., 2018; Ren et al., 2015). Exploring this link, Meier et al., (2012) found that participants who had been given a chocolate to eat (sweet taste) were willing to volunteer more of their time (prosocial behaviour) than participants who were given either a water cracker (i.e., bland taste), or no food at all (i.e., empty control). Importantly, they found no difference between the bland taste and control conditions participants on volunteering time, which suggests that the effect was not due to confounds such as the participants feeling they had to pay for the food they have been given, or the act of eating/consumption, but specific to the sweet taste. In both the water cracker condition and the chocolate condition the sensory modality of taste was stimulated as the metaphor requires. However, only the stimulation directly relevant to the metaphor (i.e., sweet tasting chocolate) activated the associated concepts (i.e., being kind, gentle, and friendly) as shown by the differences in behaviour (Meier, Moeller, et al., 2012). Thus, the inclusion of a comparator condition adds a level of specificity to the effect that is a better test of the metaphor consistent embodied effects and goes beyond "stimulation vs no stimulation".

Overview of Study 1

Having established the consistency of gustatory effects generally, the thesis turned to the exploration of the boundary conditions. The main objective was to determine how these effects that are often measured in controlled experimental situations, where differences are either controlled for or averaged across, behaved when these differences were incorporated into the study. The first empirical study of this thesis was a replication and extension of the original fishiness-suspicion effect on social (Lee & Schwarz, 2012) and cognitive decision making (Lee et al., 2015). In addition, I included the outcome measures of time taken to complete the survey and a facial trust perception measure to further explore suspicion primed by olfactory fishiness, to further demonstrate this metaphor consistent link. However, the

main aim of this study was to investigate whether personality variables moderated the observed effects.

The results of the first empirical study replicated the finding that incidental exposure to a fishy smell elicited suspicion related behaviour in line with the metaphor “something smells fishy”. Consistent with the original experiments, exposure to a fishy smell undermined cooperation (i.e., Public Goods game; Lee & Schwarz, 2012), and improved performance in cognitive decision making (i.e., Wason Rule Discovery Task; Lee et al., 2015), in comparison to exposure to a fart spray or water/control. This was interpreted as support for the inducement of suspicion by the fishy smell. Interestingly, it was also found that the presence of a fishy smell increased the time taken to complete the experimental tasks potentially indicating uncertainty and increased cognitive effort, which was a conceptually congruent effect not reported in the original experiment.

In addition to the replication predictions, it was predicted that certain traits (i.e., distrust) would interact with the embodied effects (i.e., fishy smell). However, the results revealed that the embodied effects were sufficient to override the traits that were measured. For example, in the public goods task, there was a negative correlation between distrust scores and the number of tickets given for those in the control condition, but not for those in the fishy condition. Regardless of their distrust scores, participants in the fishy smell condition tended to behave in a similar fashion to the control participants with high distrust scores, investing fewer tickets into the public pool than the participants in the other conditions.

Taken together, the results from the first study provided strong support for the embodied metaphor consistent effects of a fishy smell on a variety of outcomes related to suspicion. Indicating both the strength of the link between concrete experience and the understanding of abstract concepts, and the embodied view of cognition.

Overview of Stimuli Piloting and Study 2

For the final study I moved from looking at boundary conditions of person-variables to boundary conditions of the sensory modality utilised to activate the fishiness-suspicion link. The embodied cognition approach rejects the traditional cognitive view that mental representations consist of arbitrary or amodal symbols (Barsalou, 1999). Instead, mental representations are proposed to be modality specific and locally stored as small fractions of experience (Damasio & Damasio, 1994). For example, for the concept of *lemon*, an image of lemon is stored within the occipital lobe, and the smell of lemon is stored or represented within the olfactory area's associative cortex in the brain. A similar process is thought to occur for each of the sensorimotor senses (e.g., taste, smell, vision, touch, audition; Barsalou, 2008). This leads to a wide variety of modality (e. g., sensory) specific representations that map directly onto the physical interactions with our environment on which they are based.

The main purpose of this study was to investigate whether the fishiness-suspicion link which is considered to be grounded in the sensory modality of olfaction (e.g., Lee & Schwarz, 2012), could be primed using visual stimuli designed to evoke the olfactory concept. If fishiness itself is a concept that is stored multimodally (not just as a smell but also as an image and other aspects of an experience), then stimulating any one of those aspects would activate others too and then activate suspicion. Based on the reviewed literature I expected to find a weaker effect of the suspicion concept activation due to priming occurring outside the primary modality consistent with previous cross-modal research (e.g., Levontin et al., 2015; Slepian et al., 2014). Demonstration of attenuated cross-modality priming of a scent-based metaphor via visual stimuli would provide support for the multimodal nature of embodied cognition. In addition, this would support future research on this metaphor being conducted with online samples. The value of a suitable methodology to investigate metaphor consistent embodied effects using online samples is that it would allow efficient access to large and diverse participant samples to allow for full analyses of interactions.

As there was minimal previous research on cross-modal priming I first needed to create appropriate stimuli. Based on the research available I developed three sets of the four stimuli categories (i.e., fresh fish, smelly fish, fresh shoes, and smelly shoes) representing the perspectives observational, egoistic, and object alone. In a thought-listing task I found that participants brought to mind more category relevant thoughts when images were presented from the observational or object alone perspectives. Participants also rated the observational set of images as better representations of the target categories, than the other perspectives. I then used a masked priming lexical decision task to determine whether the smelly fish images activated the relevant metaphorically associated concept of suspicion. However, the findings from this task were inconsistent, possibly due to inhibition or suppression effects (Sassenberg & Moskowitz, 2005; Sekulak & Maciuszek, 2017), or from presenting the images in a subliminal manner. Therefore, the images selected as stimuli for the final empirical study was based solely on the findings from the thought-listing task and presented in a form where participants had time to observe and process them.

The final study examined the effect of using visual fishiness cues instead of olfactory ones in the fishiness-suspicion paradigm. I predicted that I would find results consistent with the previous research (i.e., Lee et al., 2015; Lee & Schwarz, 2012), and my first empirical study. Based on the minimal previous research that has used visual images to cross-modally prime a metaphor consistent embodied effect (Levontin et al., 2015; Park & Hadi, 2020; Rai et al., 2017; Shalev, 2014, 2016), and the potential cross-modal activation of relevant neural areas (i.e., Gonzales et al., 2006; Hauk et al., 2004) I reasoned that the effects of the images would be consistent with, though weaker, than the use of scent, this was not the case.

Broadly speaking, the findings from the second empirical study indicated that the visual stimuli were not sufficient to cross-modally prime the fishiness-suspicion link. There was no significant effect of image on outcome variables on the Public Goods Game, Wason

Rule Discovery Task, or Facial Trust Measure. There was also no interaction between visual stimuli and the individual difference measures of Distrust, Intellect, or Need for Cognition.

Contribution to Embodied Cognition

Taken together, findings from the meta-analysis and successful replication of previous research are encouraging during the current replication crisis, as they add empirical support to the validity of, and confidence in, embodied cognition theories. This is important because embodied cognition research is still in its early stages and has been targeted by detractors (e.g., Gelman & Geurts, 2017), who are critical of claims that the body, and its physical experience, play any more than a peripheral role in thoughts, behaviours, and decisions. Systematic reviews and robust findings can address these criticisms and provide a basis for confidence in the theoretical and methodological approaches used. This will be important to the future of this topic which, while embodied cognition is firmly entrenched and established within marketing psychology (i.e., Krishna, 2012), and gaining acceptance in sports psychology (Shapiro & Spaulding, 2019), educational psychology (i.e., graspable mathematics; Ottmar et al., 2015), and clinical psychology (Gjelsvik et al., 2018), is as yet to be widely accepted by the broader psychology field.

Perhaps the most novel contribution for this thesis is the findings from the first empirical study that the metaphor consistent prime was sufficient to override individual differences. This suggests that metaphor consistent physical cues (i.e., smell) in the environment may have a stronger influence on related behaviour than individual disposition. However, this finding needs replication to enhance confidence, and future research should also examine whether this is the case for other olfactory-based metaphors (e.g., disgusting smell on the severity of moral judgments; Schnall et al., 2008) and other embodied effects (e.g., tactile warmth on interpersonal trust based decisions; Williams & Bargh, 2008) before concluding that individual differences or chronic tendencies can be overridden by embodied primes. The reason for such circumspection is that, assuming the replicability of the

dominance of the fishiness-suspicion effect, it is possible that this may reflect the properties of scent being a more direct and primal sense (Kitson & McHugh, 2019). Consequently, effects via olfactory primes may be particularly strong and less prone to moderation, but this may not be the case for metaphorical primes based in other senses.

A further reason for caution in interpreting the results of Study 1 as evidence of the dominance of embodied effects over individual differences is that the specific nature of suspicion and distrust might have influenced the outcome. For example, the results show that in the control condition there was a moderate negative correlation between trait distrust and tickets invested in the public goods game which disappeared in the fishy smell condition. When exposed to the fishy smell all participants tended to behave similar to participants with high distrust did in the control condition (i.e., investing minimal tickets). In other words, participants low in distrust were greatly influenced by the smell, but participants high in distrust were not influenced at all. This fits with the distrust literature that suggests individuals low in distrust are generally more susceptible to environmental cues, or context, than individuals high in distrust (Mayer et al., 1995). As olfactory primes appear to be particularly strong environmental cues, and trait distrust particularly related to the influence of environmental cues, these results should be interpreted with caution. Nonetheless, the current findings suggest interesting directions for future research.

The fundamental claim of embodied cognition theories is that cognitive processes are influenced, and shaped by interactions between the body, the environment, and behaviour (e.g., Barsalou, 1999; Glenberg et al., 2013). It is our multi-modal experience of the world that helps us to understand and interact with it. As such, it will be interesting to see what impact the restrictive measures (i.e., social distancing, face masks) taken during the current COVID pandemic will have on our future understanding and interactions with each other. Precautionary restrictions have led to a huge increase in the number of people learning and working online (Powell, 2020), and it is very unlikely that these numbers will ever return to

pre-pandemic levels, as learning institutes and employers have realised the potential cost saving benefits from reducing infrastructure (Williamson et al., 2020). While technology allows sufficient communication for these purposes (i.e., email, video conferencing) what will be lacking is a shared multi-modal experience which I think may be a critical factor in social bonding.

Limitations and Future Research

The findings of the meta-analysis were limited to the gustatory senses. I made the choice to only investigate the gustatory senses because the planned studies of the thesis were centralised on a specific metaphor consistent embodied effect demonstrated using smell stimuli. Furthermore, olfaction has been shown to be more effective and powerful in evoking memory than other forms of perception (Royet et al., 2000), as such the stimuli used in the studies included in the meta-analysis may be particularly suitable for research in this area. Therefore, it felt like a good point from which to build the foundations of this thesis. As the sense of taste is closely linked with the sense of smell I also included findings from this domain. This means that the current findings may only provide evidence for the priming of metaphor consistent abstract concepts via gustatory stimuli.

A comprehensive meta-analysis involving metaphor consistent embodied effects from all perceptual senses (i.e., thermoception, proprioception) would greatly increase the number of studies included in the analyses, increase the statistical power of the findings, and provide more unequivocal evidence to this research domain. If the findings revealed that all perceptual senses were consistent with the overall moderate to large effect sizes obtained in my meta-analysis, then this would provide strong evidence for embodied cognition (e.g., Barsalou, 2020) and conceptual metaphor theory (e.g., Lakoff & Johnson, 1999). Including the complete range of senses would also allow comparison to be made between effects for each perceptual sense. Though the results found here provided evidence for the consistency of the effects, it is quite plausible that results for the gustatory senses are more effective in obtaining metaphor

consistent embodied effects than the other senses. This may be due to scent being the oldest and most direct of the senses (Kitson & McHugh, 2019), and gustatory senses more fundamental to survival (e.g., avoiding toxins; Zaltman, 2003), than perceptual senses that developed later. A comprehensive meta-analysis could test this claim.

It is also worth noting that the meta-analysis failed to identify all potentially relevant studies via the chosen search strategy. Research in this area is relatively new and searches for extant articles revealed a lack of consistency in the key terms, or keywords, used as identifiers. For example, 'The smell of virtue: Clean scents promote reciprocity' (Liljenquist et al., 2010) should have been identified in the initial searches for further screening but was missed as it did not include any terms related to embodied cognition or conceptual metaphor theory in their title, keywords, or abstract. There was a tendency to use cute and catchy titles to draw attention to the novel and somewhat surprising results, which added to their appeal but lacked strong consistency across the research domain. This is not entirely unexpected given that the field is yet to be established to the point of having a clear consensus on the definition of key terms, or even a widely accepted and specific definition of embodied cognition itself. As the field matures to become more cohesive and established, a shared language may develop to allow more effective search strategies.

While the results of the first empirical study indicate that individual difference factors may be secondary to embodied cognition effects, I do not expect that this would remain true for all types of individual differences. It may well be that the findings are specific to smell stimuli, or possibly only specific to suspicion. The metaphor 'something smells fishy' seems to involve readying to protect oneself from harm and therefore may have more of an overriding effect than other metaphor-consistent embodied cognition effects. It may also be the case that trait distrust is more susceptible to being altered or moderated than other traits such as core factors from the Big 5 model (i.e., Extraversion, Neuroticism; McCrae & Costa Jr, 2008). Previous research has shown that individual difference factors do play a role in

embodied cognition effects (e.g., Hauser & Schwarz, 2015), however research that integrates both individual difference factors and embodied cognition effects is very limited. Future research should seek to find what these factors may be, and when and where they may, or may not, be involved.

Finally, it must be conceded that there may well be ideal images that could elicit the required activation of the metaphor consistent embodied effects that were not found in the second empirical study. However, I suspect that the best visual stimuli may still not yield the desired results. Not having found the effects with pictures could indicate a boundary condition of the effect in that it may be constrained within the scent modality. Obviously, a non-significant effect does not mean that the effect is not possible via cross-modal stimuli, but it may be that actual smells are required for this particular effect to occur. In hindsight it would have been beneficial to include a pilot testing stage involving the lexical decision task in the presence of the actual smell stimuli from the first empirical study to provide a baseline. Cross modal priming using images has been demonstrated before for temperature related cues (Rai et al., 2017; Shalev, 2014, 2016), however as olfaction is considered to be a more primal and deeply rooted sense (Zaltman, 2003), it may well be that scent related metaphors are less prone to cross-modal activation. Further testing of a wider variety of images may be useful. More specific suggestions for the design and type of images was provided in the previous chapter.

Additional Suggestions for Future Research

Future empirical research should also consider recruiting broader and more diverse samples (e.g., Henrich et al., 2010). Increased diversity in sample pools will permit exploration of both the universality of the theories, and also potential uniqueness of effects based on variations in language and metaphor use. Previous research, and the results from first empirical study have shown that exposure to a fishy smell can influence trust based decisions via the conceptual link between fishiness and suspicion (Lee et al., 2015; Lee &

Schwarz, 2012). However, the metaphoric link between fishy smell and suspicion will not be universal if grounded in language. Though the phrase "something smells fishy" is relatively common in English speaking countries it may not be so in other countries. There are several supposed origins of this metaphor, two of which seem most plausible. First, gamblers looking to alter the result of fox hunts would drag dead fish across the trail to throw hunting dogs off the scent (Jennison, 2014). Second, the Boers used German Mauser rifles that had smokeless cartridges that helped conceal their positions. Supposedly, after firing these cartridges a lingering smell of fish would persist for several minutes. British troops moving through the area would stop and exclaim "something smells fishy", to let other troops know to duck and cover (Gustavratzenhofer, 2005). Both these scenarios are particular to the British and would explain why the metaphor might possibly be specific to English. A simpler explanation is that English fish markets were quite dirty (near industrial areas) and merchants were not above selling dubious products.

In the Norwegian language the metaphor in question is not common. Norwegian culture does have metaphors about fish but they tend to be of a different focus. For example, "Frisk som en fisk (as healthy as a fish)", and "trives som fisken i vannet (thrive as a fish in the water)" (A. F. Rydning, personal communication, February 20, 2014). These expressions suggest that there are culturally defined conceptual-perceptual links reflecting different metaphors. Norwegian origin sagas also discuss how any deviant behaviour by a group member (i.e., dodgy fish trader) led to ostracism and sometimes execution (C. Lachaud, personal communication, February 17, 2014). Combined with the Norwegian climate (fish kept fresh longer) it seems plausible that there was less chance of purchasing an illness inducing product, and hence a need to be suspicious.

In terms of suspicion related metaphors in Norwegian they do also relate to ‘something smells’, but it is not the scent of fish. Demonstrating that the fishiness-suspicion link is not effective with Norwegian participants would provide further support for conceptual

metaphor and embodied cognition theories, I would expect that a bad smell (i.e., fart spray) may elicit suspicion, but not the fishy smell. As most Norwegians, and all younger Norwegians, are fluent in English and frequently watch American TV it would also be interesting to present the study in both English and Norsk to examine if there is an effect of language.

One notable criticism of conceptual metaphor theory is that researchers appear to be handpicking metaphors that may be more likely to work (Low et al., 2010), rather than conducting any deep research on how frequently these metaphors are used in daily language, which may lead to confirmation bias (Kövecses, 2017). Future researchers can address this concern by collaborating with psycholinguists to gain an understanding of how frequently each potential metaphor is used in everyday language (Gibbs, 2014), and identify any cross-cultural variation in meaning.

Though not directly specific to embodied cognition research a key strength of the research presented in this thesis is the continued trend or pattern in the perceptions of facial trustworthiness shown here and in the previous empirical study. Increasing distrust and suspicion leads to the rating of untrustworthy faces as more untrustworthy, however while increasing distrust appears to have a consistent lessening of ratings across all valences of faces, suspicion appears to make responses at both ends of the valence more extreme, with increasing suspicion leading to perceiving trustworthy faces as more trustworthy. It would appear that the effects of suspicion are distinct from the effects of distrust, separating these constructs that are often considered as essentially similar (Griffiths, 2014; Kramer, 1998). There is limited research exploring this distinction between concepts, however, Sinaceur (2009) suggests that there is an important distinction between these concepts with distrust implicated in automatic decision making, while suspicion effects level of uncertainty, and generates further search for information. This was reflected in the results of the first study. Specifically, participants whose suspicion was induced via exposure to the fishy smell were

more likely to avoid confirmation bias than other participants, yet there was no relationship between trait distrust and behaviour in the Wason Rule Discovery Task.

Concluding Remarks

Research on metaphor consistent embodied effects is accumulating quickly, and the field is gaining traction and acceptance throughout contemporary psychology. While the detractors remain adamantly against the embodied cognition perspective their numbers may be decreasing (Farina, 2020). In order for the field to continue to gain momentum it is necessary that further research is conducted involving both large scale direct replications, and more nuanced experiments that explore the mechanisms behind these metaphor consistent embodied effects. The findings from the current thesis indicate that the perceptual-conceptual link between fishy smells and suspicion previously demonstrated by Lee and Schwarz (2012) is relatively stable across (albeit similar cultural samples) that are familiar with the metaphor 'something smells fishy', and is not constrained, or limited, by individual difference factors. Furthermore, it may be a modality specific effect and bounded within the sense of olfaction. However, as smell is considered a chemical, and more primal sense than others it is recommended that similar research is conducted across metaphor consistent embodied effects associated with other perceptual senses before these findings can be extended to the broader domain.

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Chapter 9 : Appendices

Appendix A: Supplementary Material for the Meta-Analysis

Table 9.1

Quality Scoring Details for Studies Included in the Meta-Analysis

	A priori power	Experimenter blind to condition	Random assignment	Effect size stated	Awareness probe	N>30	Age**	Gender**	Total
Lee et al., (2015), study 1	1	1	1	1	0	1	0	1	5.50
Lee et al., (2015), study 2	1	1	1	1	0	1	0	1	5.50
Ding et al., (2016), study 3	0	0	1	1	0	1	1	1	4.00
Eskine et al., (2011)	0	0	1	1	1	1	0	1	4.50
Gilead et al., (2015)	1	0	1	1	1	1	1	1	6.00
Hellman et al., (2013), study 1	0	0	0*	1	0	1	1	1	3.00
Hellman et al., (2013), study 2	0	0	0*	1	0	1	1	1	3.00
Meier et al., (2012), study 4	0	0	1	1	0	1	1	1	4.00
Meier et al., (2012), study 5	0	0	1	1	0	1	1	1	4.00
Ren et al., (2015), study 1	0	0	1	1	1	1	1	1	5.00
Ren et al., (2015), study 2	0	0	1	1	1	1	1	1	5.00
Ren et al., (2015), study 3	0	0	1	1	0	1	1	1	5.00
Lee & Schwarz (2012), study 1	0	1	1	1	1	1	1	1	6.00
Lee & Schwarz (2012), study 2	0	1	1	1	1	1	1	1	5.00
Saglioglou & Greitmeyer (2014), study 1	0	0	1	1	0	1	1	1	4.00
Saglioglou & Greitmeyer (2014), study 2	0	0	1	1	0	1	1	1	4.00
Saglioglou & Greitmeyer (2014), study 3	0	0	1	1	0	1	1	1	4.00
Schnall et al., (2008), study 1	0	0	1	1	1	1	0	1	4.50
Troisi & Gabriel (2011), study 1	0	1	1	1	1	1	1	1	6.00

*Random assignment not specifically stated. ** Half points for providing age and for providing gender demographics.

Table 9.2

Alternate Output for the Control Group Meta-Analysis with Additional Studies

	Study name	Hedges' g	CI Lower limit	CI Upper limit	Weight
1	S. Lee & Schwarz (1;2012)	0.81	0.07	1.59	2.64%
2	S. Lee & Schwarz (2;2012)	0.91	0.36	1.48	4.73%
3	Schnall, Haidt, Clore & Jordan (2008)	0.75	0.30	1.21	6.91%
4	Eskine, Kacinik, & Prinz (2011)	1.12	0.42	1.86	2.87%
5	Saglioglo & Greitmeyer (2;2014)	0.69	0.08	1.32	3.89%
6	Saglioglo & Greitmeyer (3;2014)	0.55	0.24	0.87	14.46%
7	Troisi & Gabriel (2011)	0.56	0.04	1.10	5.17%
8	Ren, Tan, Arriaga, & Chan (1;2014)	0.54	0.07	1.02	6.43%
9	Ren, Tan, Arriaga, & Chan (2;2014)	0.29	-0.04	0.62	12.89%
10	Hellmann, Thoben, & Echterhoff (2;2013)	0.79	0.03	1.60	2.49%
11	D. Lee, Kim, & Schwarz (1;2015)	0.70	0.19	1.23	5.34%
12	D. Lee, Kim, & Schwarz (2;2015)	0.47	0.06	0.90	8.16%
13	Meier, Moeller, Reimer-Peltz, &	0.74	0.07	1.44	3.18%
14	Liljenquist, Zhong, & Galinsky (S1; 2010)	1.00	0.23	1.83	2.38%
15	Liljenquist, Zhong, & Galinsky (S2; 2010)	0.47	0.05	0.89	8.00%
16	Miska, Hemmesch, & Buswell (S1a: 2018)	0.55	0.03	1.08	5.21%
17	Miska, Hemmesch, & Buswell (S1b: 2018)	0.48	-0.04	1.01	5.25%

Figure 9.1

Alternate Forest Plot for the Control Group Meta-Analysis with Additional Studies

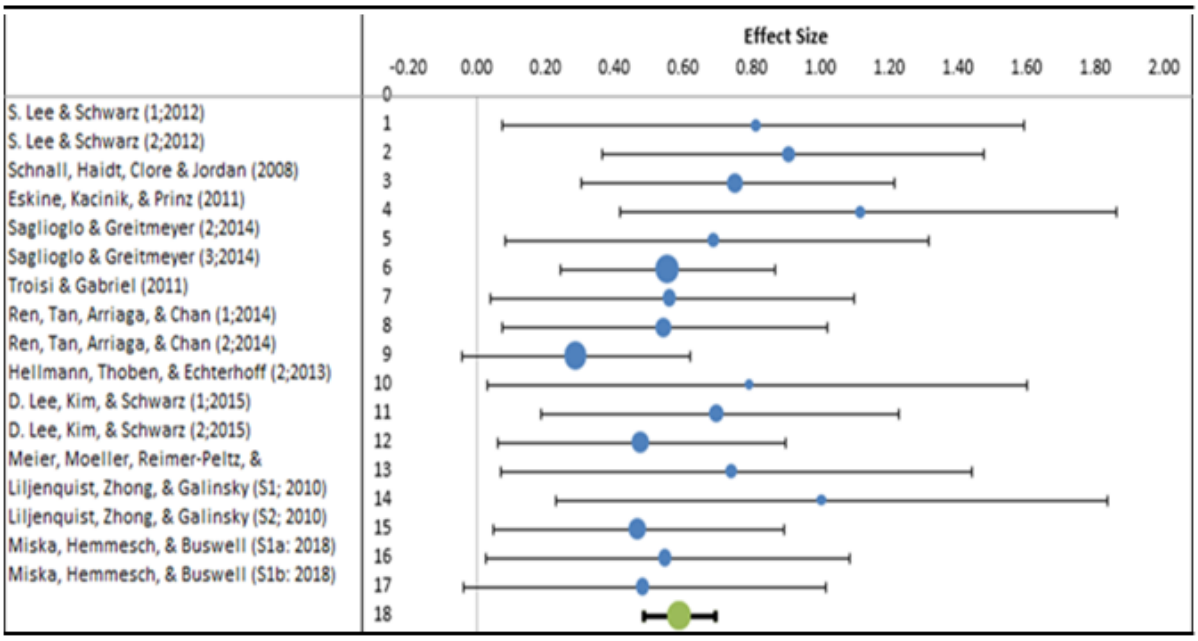


Figure 9.2

Alternate Funnel Plot for the Control Group Meta-Analysis with Additional Studies

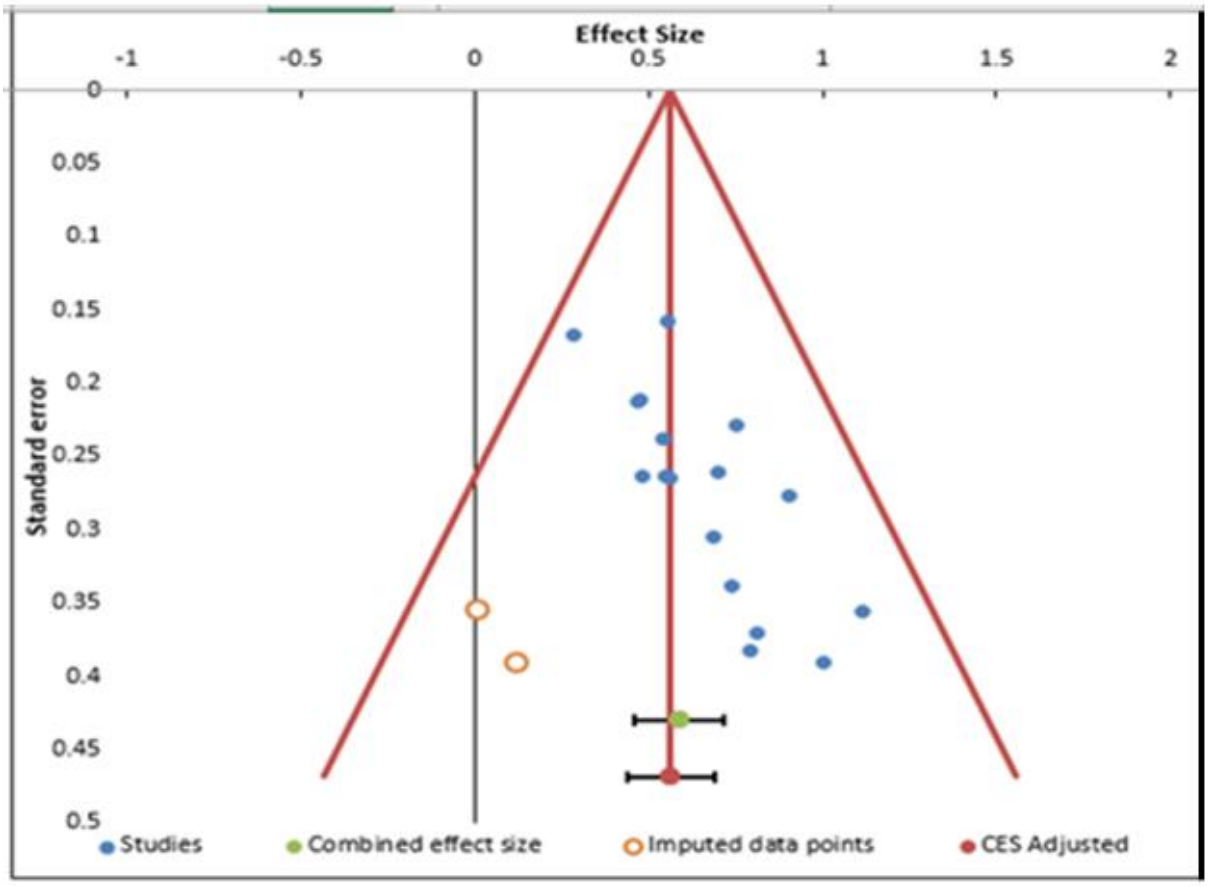


Table 9.3

Alternate Output for the Comparator Group Meta-Analysis with Additional Studies

	Study name	Hedges' g	CI Lower limit	CI Upper limit	Weight
1	S. Lee & Schwarz (1;2012)	0.76	0.04	1.53	4.67%
2	S. Lee & Schwarz (2;2012)	0.54	0.00	1.10	8.25%
3	Eskine et al., (2011)	1.28	0.54	2.07	4.37%
4	Saglioglou & Greitmeyer (1; 2014)	1.14	0.66	1.64	10.12%
5	Meier et al., (4; 2012)	0.60	0.08	1.14	8.77%
6	Meier et al., (5; 2012)	0.58	-0.07	1.25	5.86%
7	Ding et al., (3; 2016)	1.26	0.60	1.97	5.32%
8	Gilead et al., (2015)	0.71	0.20	1.24	9.20%
9	Ren et al., (1; 2014)	0.80	0.35	1.26	11.77%
10	Hellman et al., (2; 2013)	0.61	-0.02	1.26	6.13%
11	Miska, Hemmesch, & Buswell (S1a: 2018)	0.61	0.09	1.15	8.77%
12	Miska, Hemmesch, & Buswell (S1b: 2018)	0.70	0.18	1.25	8.64%
13	Yu et al., (2013)	0.71	0.16	1.27	8.13%

Figure 9.3

Alternate Forest Plot for the Comparator Group Meta-Analysis with Additional Studies

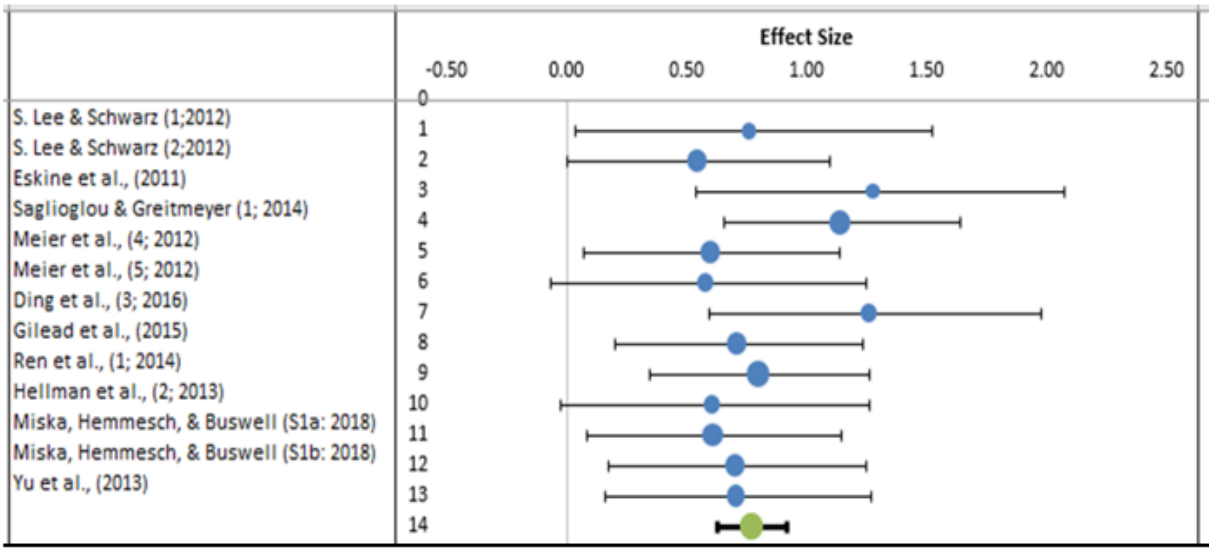
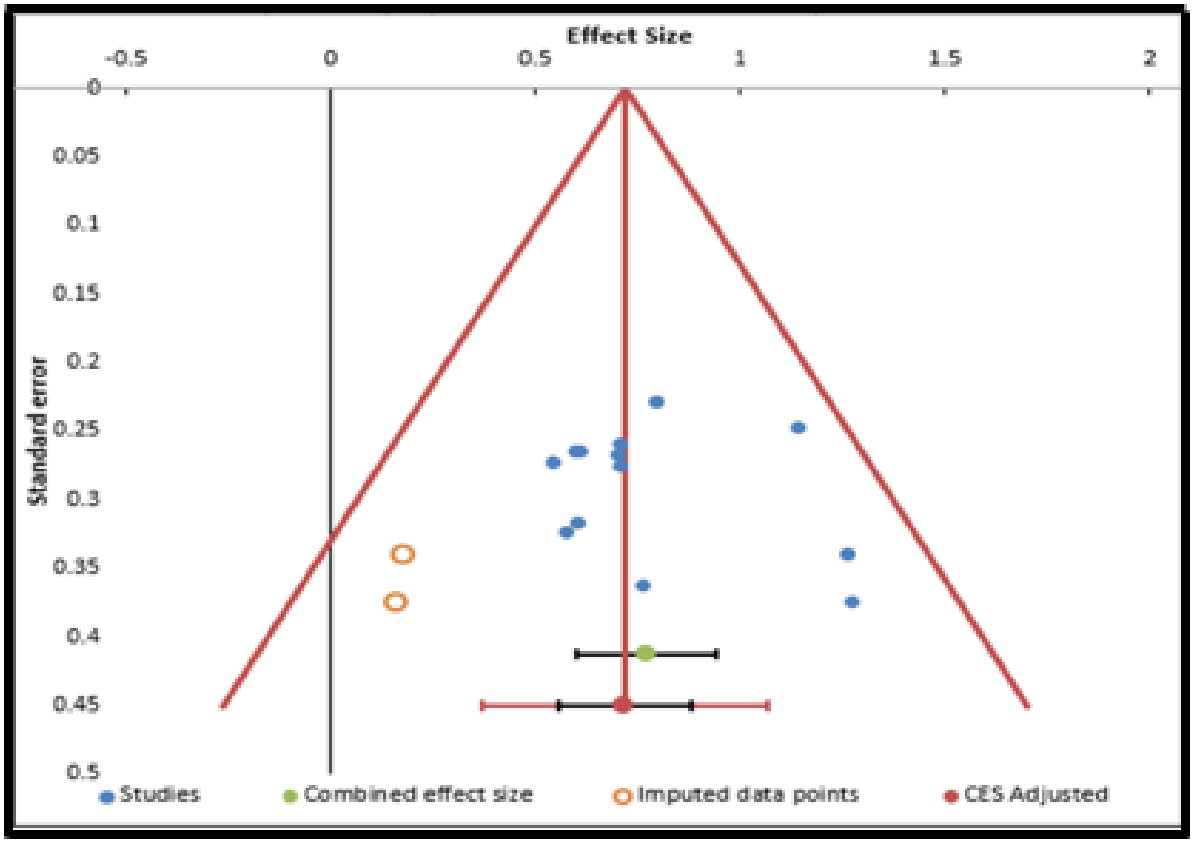


Figure 9.4

Alternate Funnel Plot for the Comparator Group Meta-Analysis with Additional Studies



Appendix B: Measures used in the Experimental Studies

B.1. Demographics

What is your gender?

- Male
- Female
- Do not wish to say

What is your age in years?

What is the highest level of education you have completed?

- High School
- Some university/tertiary
- Undergraduate degree
- Postgraduate degree

In which country do you reside?

In which country were you born?

*How long have you lived in Australia?

*Are you a native English speaker?

*What is your native language?

*Are you a fluent English speaker?

Note: *Display of these items was dependent on other responses.

B.2. Distrust Scale

Goldberg et al., (2006)

Describe yourself as you honestly see yourself, in relation to other people you know of the same gender you are and roughly the same age. Indicate for each statement whether it is:

	Very inaccurate	**Moderately inaccurate**	**Neither accurate nor inaccurate**	**Moderately accurate**	**Very accurate**
I find it hard to forgive others	○	○	○	○	○
I suspect hidden motives in others	○	○	○	○	○
I am wary of others	○	○	○	○	○
I distrust people	○	○	○	○	○
I believe that people seldom tell you the whole truth	○	○	○	○	○
I believe that people are essentially evil	○	○	○	○	○
*I trust what people say	○	○	○	○	○
*I trust others	○	○	○	○	○
*I believe that others have good intentions	○	○	○	○	○
*I believe that people are basically moral	○	○	○	○	○

Note: *Items are reversed scored. Order randomised before presentation to participants

B.3. Intellect Scale

Goldberg et al., (2006)

Describe yourself as you honestly see yourself, in relation to other people you know of the same gender you are and roughly the same age. Indicate for each statement whether it is:

	Very inaccurate	**Moderately inaccurate**	**Neither accurate nor inaccurate**	**Moderately accurate**	**Very accurate**
Have a rich vocabulary	○	○	○	○	○
Have a vivid imagination	○	○	○	○	○
Have excellent ideas	○	○	○	○	○
Am quick to understand things	○	○	○	○	○
Use difficult words	○	○	○	○	○
Spend time reflecting on things	○	○	○	○	○
Am full of ideas	○	○	○	○	○
*Have difficulty understanding abstract ideas	○	○	○	○	○
*Am not interested in abstract ideas	○	○	○	○	○
*Do not have a good imagination	○	○	○	○	○

Note: *Items are reversed scored. Order randomised before presentation to participants

B.4. General Trust Scale

Yamagishi & Yamagishi (1994).

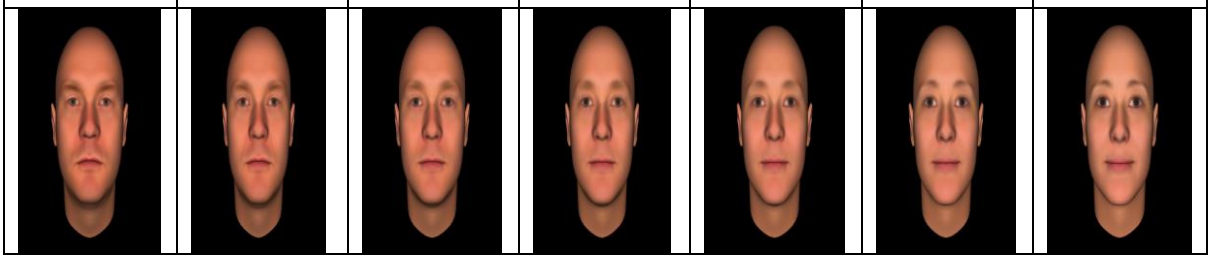
Describe yourself as you honestly see yourself, in relation to other people you know of the same gender you are and roughly the same age. Indicate for each statement whether it is:

	Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
Most people are basically honest	○	○	○	○	○
Most people are trustworthy	○	○	○	○	○
Most people are basically good and kind	○	○	○	○	○
Most people are trustful of others	○	○	○	○	○
I am trustful	○	○	○	○	○
Most people will respond in kind when they are trusted by others	○	○	○	○	○
Am full of ideas	○	○	○	○	○

B.5. Facial Trust Measure.

(Oosterhof & Todorov, 2008).

Stimuli used in the facial trust measure

Facial Trust Measure Stimuli						
-3	-2	-1	0	+1	+2	+3
						
						

B.6. Need for cognition Scale

Cacioppo et al., (1984) used in Study 2 only

Instructions:

For each of the statements below, please indicate to what extent the statement is characteristic of you.
If the statement is extremely uncharacteristic of you (not at all like you) click on the first column; if the statement is extremely characteristic of you (very much like you) please click on the last.
Of course, a statement may be neither extremely uncharacteristic nor extremely characteristic of you; if so, please use the numbers in the middle of the scale that describes the best fit.

Please keep the following scale in mind as you rate each of the statements below:
1 = extremely uncharacteristic;
2 = somewhat uncharacteristic;
3 = uncertain;
4 = somewhat characteristic;
5 = extremely characteristic.

	1	**2**	**3**	**4**	**5**
I would prefer complex to simple problems.					
I like to have the responsibility of handling a situation that requires a lot of thinking.					
*Thinking is not my idea of fun.					

*I would rather do something that requires little thought than something that is sure to challenge my thinking abilities					
*I try to anticipate and avoid situations where there is a likely chance I will have to think in depth about something					
*I only think as hard as I have to.					
*I prefer to think about small, daily projects than long-term ones					
*I like tasks that require little thought once I've learned them					
The idea of relying on thought to make my way to the top appeals to me.					
I really enjoy a task that involves coming up with new solutions to problems					
*Learning new ways to think doesn't excite me very much					
I prefer my life to be filled with puzzles that I must solve					
The notion of thinking abstractly is appealing to me					
I would prefer a task that is intellectual, difficult, and important to one that is somewhat important but does not require much thought					
*1 feel relief rather than satisfaction after completing a task that required a lot of mental effort					
*It's enough for me that something gets the job done; I don't care how or why it works					
I usually end up deliberating about issues even when they do not affect me personally					

Note: *Items are reversed scored.

Appendix C: HREC Study Approval Certificates

Study 1 Approval Certificate

Australian Catholic University Human Research EthicsCommittee

Project Approval Certificate

Chief Investigator/Supervisor:	Dr Leah Kaufmann
Co-Investigator:	Dr Xochitl De la Piedad Garcia
Student Researcher:	Prem Sebastian
Project title:	Investigating the moderation of embodied cognition effects via individual differences
Project approval date:	6 July 2015
Project approval end date:	31 December 2016
Human Research Ethics Committee (HREC) Register Number:	2015-76H

This is to certify that the above application was reviewed by the Australian Catholic University Human Research Ethics Committee (ACU HREC) and approved for the period given above.

Continued approval of this research project was contingent upon the submission of annual progress reports due on/before each anniversary of the project approval. A final report was submitted upon completion of the project.

Researchers are responsible for ensuring that all conditions of approval are adhered to and that any modifications to the protocol, including changes to personnel, are approved prior to implementation. In addition, the ACU HREC must be notified of any reportable matters including, but not limited to, incidents, complaints and unexpected issues.

Researchers are also responsible for ensuring that they adhere to the requirements of the *National Statement on Ethical Conduct in Human Research,* the *Australian Code for the Responsible Conduct of Research* and the University's *Research Code of Conduct*.

Any queries relating to this application should be directed to the Research Ethics and Integrity Office (Res.Ethics@acu.edu.au).

Kind regards,

20/02/2020

Nina Robinson

Research Ethics & Integrity Officer
On behalf of the ACU HREC Chair, Associate Professor Michael Baker

Research Ethics and Integrity | Research Services | Office of the Deputy Vice-Chancellor (Research) Australian Catholic University
T: +61 2 9739 2646
E: Res.Ethics@acu.edu.au
W: ACU Research Ethics and Integrity

Study 2 Approval Certificate

Australian Catholic University Human Research Ethics Committee

Project Approval Certificate

Chief Investigator/Supervisor:	Dr Leah Kaufmann
Co-Investigator:	Dr Xochitl De la Piedad Garcia
Student Researcher:	Prem Sebastian
Project title:	Cross-Modal priming of a conceptual metaphor
Project approval date:	15 June 2015
Project approval end date:	31 December 2017
Human Research Ethics Committee (HREC) Register Number:	2015-70E

This is to certify that the above application was reviewed by the Australian Catholic University Human Research Ethics Committee (ACU HREC) and approved for the period given above.

Continued approval of this research project was contingent upon the submission of annual progress reports due on/before each anniversary of the project approval. A final report was submitted upon completion of the project.

Researchers are responsible for ensuring that all conditions of approval are adhered to and that any modifications to the protocol, including changes to personnel, are approved prior to implementation. In addition, the ACU HREC must be notified of any reportable matters including, but not limited to, incidents, complaints and unexpected issues.

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Kind regards,

20/02/2020

Nina Robinson

Research Ethics & Integrity Officer
On behalf of the ACU HREC Chair, Associate Professor Michael Baker

Research Ethics and Integrity | Research Services | Office of the Deputy Vice-Chancellor (Research) Australian Catholic University
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E: Res.Ethics@acu.edu.au
W: ACU Research Ethics and Integrity

Appendix D: Information Letters and Consent Forms

Study 1 Information Letter

PARTICIPANT INFORMATION LETTER

PROJECT TITLE: **Personality Influences on Decision Making**
PRINCIPAL INVESTIGATOR: **Dr. Leah Kaufmann**
STUDENT RESEARCHER: **Mr. Prem Sebastian**
STUDENT'S DEGREE: **Doctor of Philosophy**

Dear Participant,
You are invited to participate in the research project described below.

What is the project about?

The research project investigates the influence of personality differences on decision making tasks. It is of particular interest to examine if the influence is dependent on the type of task, or is consistent across the various tasks that will be used.

Who is undertaking the project?

This project is being conducted by Mr. Prem Sebastian and will form the basis for the degree of Doctor of Philosophy at Australian Catholic University under the supervision of Dr. Leah Kaufmann.

Are there any risks associated with participating in this project?

There are no foreseeable risks associated with participation in this project beyond the inconvenience of the time required to complete the study.

What will I be asked to do?

Participants will be required to complete a brief personality questionnaire, and then three decision making tasks. Once completed, participants will be asked to complete a short survey about their experience and will provide basic demographic information. Testing will be completed in a single one-off session, and is expected to take approximately 30 minutes.
All participation will take place on the ACU Melbourne campus.

How much time will the project take?

Participation involves a single face-to-face session which will take approximately 30 minutes. ACU School of Psychology Students may apply for 0.75% course credit as reimbursement for their participation.

What are the benefits of the research project?

There are no direct benefits to participants beyond course credit. However, this research project will contribute to the scientific understanding of decision making and related behaviour.

Can I withdraw from the study?

Participation in this study is completely voluntary. You are not under any obligation to participate. If you agree to participate, you can withdraw from the study at any time without adverse consequences. However, as data will be non-identifiable it cannot be withdrawn after submission.

Will anyone else know the results of the project?

The results of the study may be published in a scholarly research article and may also be presented at a conference. Data collection will not involve the collection of personally identifiable information and so published results will not be individually identifiable. Any publication will present only aggregated data.

Will I be able to find out the results of the project?

Participants should contact the researchers if they are interested in the outcome of the current research.

Who do I contact if I have questions about the project?

Any questions regarding this project can be directed to the Principal Investigator:

Dr. Leah Kaufmann
School of Psychology, Australian Catholic University
115 Victoria Parade, Fitzroy VIC 3065
Telephone: 9953 3015

What if I have a complaint or any concerns?

The study has been reviewed by the Human Research Ethics Committee at Australian Catholic University (**Approval Code 2015-76H**). If you have any complaints or concerns about the conduct of the project, you may write to the Manager of the Human Research Ethics Committee care of the Office of the Deputy Vice Chancellor (Research).

Manager, Ethics
c/o Office of the Deputy Vice Chancellor (Research)
Australian Catholic University
North Sydney Campus
PO Box 968
NORTH SYDNEY, NSW 2059
Ph.: 02 9739 2519
Fax: 02 9739 2870
Email: resethics.manager@acu.edu.au

Any complaint or concern will be treated in confidence and fully investigated. You will be informed of the outcome.

I want to participate! How do I sign up?

Participants can sign up to participate through the School of Psychology Research Participation System (SONA).
Yours sincerely,

Dr. Leah Kaufmann
Principal Investigator

Mr. Prem Sebastian
Student Researcher

Study 2 Information Letter

PROJECT TITLE: **Individual Differences and Social Decision Making**
PRINCIPAL INVESTIGATOR: **Dr. Leah Kaufmann**
STUDENT RESEARCHER: **Mr. Prem Sebastian**
STUDENT'S DEGREE: **Doctor of Philosophy**

Dear Participant,
You are invited to participate in the research project described below.

What is the project about?

The research project investigates the possible links between individual differences and performance on social decision-making tasks. It is of particular interest to examine if the influence of individual differences is consistent or varies across different types of decision-making tasks (i.e., context).

Who is undertaking the project?

This project is being conducted by Mr. Prem Sebastian and will form the basis for the degree of Doctor of Philosophy at Australian Catholic University under the supervision of Dr. Leah Kaufmann.

Are there any risks associated with participating in this project?

There are no foreseeable risks associated with participation in this project beyond the inconvenience of the time required to complete the study.

What will I be asked to do?

Participants will access the study via the online website. The study will involve the completion of: individual difference measures (e.g., personality), a memory task which will ask you to recall details of a series of images; and three separate decision making tasks. Finally, participants will be debriefed and asked to provide basic demographic information (e.g., age, gender, ethnicity).

How much time will the project take?

Testing will be completed in a single online session and is expected to take approximately 30 minutes. ACU School of Psychology Students may apply for 0.5% course credit as reimbursement for their participation.

What are the benefits of the research project?

There are no direct benefits to participants beyond course credit. However, this research project will contribute to the scientific understanding of decision making and related behaviour.

Can I withdraw from the study?

Participation in this study is completely voluntary. You are not under any obligation to participate. If you agree to participate, you can withdraw from the study at any time without adverse consequences. However, as data will be non-identifiable, data cannot be withdrawn after submission.

Will anyone else know the results of the project?

The results of the study may be published in a scholarly research article and may also be presented at a conference. Data collection will not involve the collection of personally identifiable information and so published results will not be individually identifiable. Any publication will present only aggregated data.

Will I be able to find out the results of the project?

Participants should contact the researchers if they are interested in the outcome of the current research.

Who do I contact if I have questions about the project?

Any questions regarding this project can be directed to the Principal Investigator:

Dr Leah Kaufmann
School of Psychology, Australian Catholic University
115 Victoria Parade, Fitzroy VIC 3065
Telephone: 03 9953 3015

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Manager, Ethics
c/o Office of the Deputy Vice Chancellor (Research)
Australian Catholic University
North Sydney Campus
PO Box 968
NORTH SYDNEY, NSW 2059
Ph.: 02 9739 2519
Fax: 02 9739 2870
Email: resethics.manager@acu.edu.au

Any complaint or concern will be treated in confidence and fully investigated. You will be informed of the outcome.

I want to participate! How do I sign up?

Participants can sign up to participate through the School of Psychology Research Participation System (SONA).

Yours sincerely,

Dr Leah Kaufmann
Principal Investigator

Mr. Prem Sebastian
Student Researcher

Study 1 Consent Form

CONSENT FORM
Copy for Researcher

TITLE OF PROJECT: .....**Personality Influences on Decision Making**

PRINCIPAL INVESTIGATOR: .....Dr. Leah Kaufmann

STUDENT RESEARCHER.....Prem Sebastian

I ..... *(the participant)* have read (*or, where appropriate, have had read to me)* and understood the information provided in the Letter to Participants. Any questions I have asked have been answered to my satisfaction. I agree to participate in this 30 minute study, consisting of three computerised decision making tasks, and two paper questionnaires. I realise that I can withdraw my consent at any time without adverse consequences. I agree that research data collected for the study may be published or may be provided to other researchers in a form that does not identify me in any way.

NAME OF PARTICIPANT: .....

SIGNATURE ..... DATE .....

SIGNATURE OF PRINCIPAL INVESTIGATOR:.....

DATE.....

SIGNATURE OF STUDENT RESEARCHER:.....

DATE.....

Study 2 Consent Form (presented online)

Do you agree to participate in this survey?

In selecting '**Yes**' below, you confirm that you:

- Have read and understood the information provided on the participant information statement (on the previous page) and consent form (this page)
- Agree to participate in this project by completion of the questions and tasks in this survey
- Realise you may cease to answer questions at any time, and any information provided prior to submission will not be retained
- Realise that due to the anonymity of data collected, after final submission of your answers you may not withdraw consent to participate or retract any provided information
- Agree that research data gained through your participation in this study may be used in publications, or presented at conferences
- Understand that research data gained through you participating in this study may be used in future research studies relating to this project
- Are at least 18 years of age

This agreement is based on the condition that the information you provide will be anonymous.

In selecting '**No**' below, you will be directed to the end of this survey and no data will be collected from you.