The Role and Mechanisms of Olfaction in Social Judgment and Decision-Making: Postprint

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Date: 2023-10-09T00:00:00+00:00

Abstract

Olfaction is an "adaptor" evolved by humans to solve problems of survival and reproduction. Extensive research has confirmed that olfaction influences individuals' interpersonal perception and moral judgment, and affects their decision-making in prosocial behavior, risk behavior, and consumer behavior; however, no literature has systematically explored the underlying mechanisms of these effects. Based on a review of various studies, and from the dimensions of phylogenetic development, physical, emotional, cognitive, and interpersonal aspects, this paper organizes and summarizes five hypotheses—the evolutionary hypothesis, physiological hypothesis, emotion induction hypothesis, embodied cognition hypothesis, and social construction hypothesis—to elucidate the mechanisms through which olfaction influences social judgment and decision-making at multiple levels. Current research suffers from issues such as individual differences in odor perception, varied manipulation methods of odor dosage and exposure time across different studies, and insufficient consideration of cross-modal information integration in olfaction. Future research should strengthen investigations into olfaction in areas such as cross-modal integration, localization and cross-cultural studies, as well as social life domains such as consumer psychology.

Full Text

The Effect of Olfaction on Social Judgment and Decision-Making and Its Mechanism

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Abstract

Olfaction represents an evolutionary adaptation that enabled human ancestors to solve fundamental problems of survival and reproduction. Extensive research confirms that olfactory cues influence interpersonal perception and moral judgment, shaping decisions related to prosocial behavior, risk-taking, and consumer behavior. However, no comprehensive review has systematically examined the underlying mechanisms of these effects. This paper synthesizes diverse empirical studies and proposes five hypotheses—evolutionary, physiological, emotion-induction, embodied cognition, and social construction—to explain how olfaction affects social judgment and decision-making across phylogenetic, bodily, emotional, cognitive, and interpersonal dimensions. Current research faces challenges including individual differences in odor perception, inconsistent manipulation of odor dosage and exposure duration across studies, and inadequate consideration of cross-modal information integration. Future research should strengthen investigations into cross-modal processing, localization and cross-cultural factors, and applications in social contexts such as consumer psychology.

Keywords: olfaction, social judgment, social decision-making, mechanism
Classification Code: B842

"The scent of dark plum drifts from afar, for it is not snow but fragrance that I know." Olfaction ranks among the most ancient sensory modalities in human evolution, arising when odorant molecules stimulate receptors in the olfactory mucosa, generating neural impulses that travel along the olfactory nerve to the olfactory bulb (Chen et al., 2017). Unlike other senses, olfaction can receive chemical information over long distances, profoundly influencing mate selection and food choice—processes critical to human survival and reproduction (Ferdenzi et al., 2016; Velluzzi et al., 2022).

While olfactory research has traditionally concentrated on physiology and medicine, focusing on the neural mechanisms and treatment of olfactory disorders (Li et al., 2020; Zhang et al., 2021), psychological investigations have shifted from early work on emotion and memory to an emerging body of research examining olfaction' s impact on social judgment and decision-making. Humans can infer others' age, gender, and even health status through smell (Boesveldt & Parma, 2021). Nevertheless, these findings remain scattered across empirical studies from diverse perspectives, lacking a systematic literature review. This paper aims to synthesize these studies, review olfaction' s influence on social decision-making, and organize five theoretical hypotheses to explain its underlying mechanisms.

1.1.1 The Influence of Non-Social Olfactory Information on Interpersonal Perception and Judgment

Non-social odors systematically alter how individuals perceive and evaluate others. Cook et al. (2015) investigated how inhaling three different odors—jasmine fragrance, methanethiol (a foul smell), and clean air—affected ratings of pleasantness for neutral facial expressions. Results revealed that neutral faces presented with jasmine fragrance received the highest pleasantness ratings, while those paired with methanethiol received the lowest. Importantly, this effect persisted even when odor and face presentations were asynchronous, demonstrating that olfactory cues can independently modify facial evaluations. When neutral faces were repeatedly paired with aversive odors, participants developed more negative attitudes toward those faces, experienced more negative emotions, and tended to attribute these evaluations to personal traits rather than situational factors (Homan et al., 2017). Sellaro et al. (2015) found that compared to odorless and peppermint conditions (which increase arousal), exposure to lavender aroma (a relaxing scent) led participants to perceive greater commonality between themselves and others. Croijmans et al. (2021) further demonstrated that pleasant fragrances caused women to rate men in videos as having higher self-esteem and attractiveness.

Beyond individual perception, non-social odors shape judgments about interpersonal relationships. Van Nieuwenburg et al. (2019) discovered that hexanal—a grassy compound found in both body odor and lavender—increased interpersonal trust and elevated trustworthiness ratings of random faces. Conversely, Cunningham et al. (2013) showed that compared to odorless conditions, exposure to sweat (highly disgusting) and cheese (moderately disgusting) odors significantly increased rejection of gay men, suggesting that aversive olfactory stimuli may constitute an important factor in outgroup avoidance. Questionnaire research further reveals that individuals with higher sensitivity and disgust toward malodors exhibit greater prejudice toward immigrants and refugees, more readily believing that outgroups possess fundamentally different hygiene practices from their ingroup (Zakrzewska et al., 2019). This indicates that olfaction likely participates in and shapes social attitudes toward outgroups.

Finally, non-social odors influence self-perception and judgment. Research on Alzheimer' s patients found that when answering "Who am I?" in the presence of odors, patients generated more statements about their physical, psychological, and social roles, suggesting that odor exposure may improve self-concept accessibility (Glachet & Haj, 2020). Barnett et al. (2022) compared individuals exposed to putrescine (the smell of decaying organic matter, termed "the smell of death"), ammonia (present in many cleaning products), or water (odorless). Both putrescine and ammonia groups reported higher life satisfaction than the odorless control, suggesting that disgusting odors may activate psychological threat systems, leading individuals to appreciate their lives more and consequently report greater satisfaction.

1.1.2 The Influence of Non-Social Olfactory Information on Moral Judgment and Decision-Making

Non-social odors significantly impact moral judgment and decision-making. Disgusting odors tend to make moral judgments more severe, while pleasant odors render them more lenient. Holland et al. (2005) found that exposure to citrus cleaner scent activated cleanliness concepts, increased sensitivity to cleaning-related vocabulary, and prompted more cleaning behaviors such as bathing and tidying. Schnall et al. (2008) demonstrated that both strong and mild disgusting odors produced harsher moral judgments compared to odorless conditions, indicating that aversive odors shift moral evaluation standards toward greater strictness.

Liljenquist et al. (2010) examined how clean scents influence reciprocity and charitable behavior, finding that participants exposed to clean scents engaged in more cleaning behaviors, displayed greater mutual assistance in anonymous games, and exhibited more generosity in donation activities. De Lange et al. (2012) conducted a field experiment on trains, releasing clean scents in two carriages and comparing them to two normal-scent carriages. Passengers in scented carriages discarded significantly less trash by both weight and quantity. Guéguen (2012a) similarly found that pedestrians near shops with pleasant ambient odors (such as bakeries) were more willing to help an experimenter pick up a dropped glove, demonstrating that pleasant environmental odors facilitate helping behavior.

Cecchetto et al. (2017) discovered that even neutral odors can affect moral decisions. Compared to butyric acid at subthreshold concentration (which has hedonic ambiguity—individuals may perceive it as pleasant or unpleasant), cedar oil (a neutral odor) made participants more likely to accept deontological moral judgments (judging actions by their inherent morality rather than utilitarian outcomes). Previous research has shown that high physiological arousal leads to utilitarian moral decisions, while deontological tendencies show the opposite pattern (Moretti et al., 2010). Thus, cedar oil odor may influence decision-making by reducing arousal levels.

The mechanisms underlying olfaction's influence on moral judgment are complex. At the physiological level, Sharvit et al. (2020) compared the roles of disgusting olfactory stimuli and painful thermal stimuli in moral cognition, finding that after reading about moral transgressions, brain regions associated with olfaction—but not pain—were activated, suggesting a specific neural link between olfactory disgust and moral cognition. At the cognitive level, Białek et al. (2021) created disgusting odors using animal repellent in trash cans and found that while different odor concentrations did not differentially affect moral judgments, participants' self-reported disgust levels predicted stricter moral standards. From an emotional perspective, some researchers argue that moral dilemmas or trans-

gressions inherently evoke disgust, which then alters attitudes toward neutral behaviors and increases the likelihood of moral action (Landy & Goodwin, 2015). However, Kugler et al. (2021) challenge this view, using different methods to induce disgust but finding no effect on moral behavior.

1.1.3 The Influence of Non-Social Olfactory Information on Other Social Decisions

Non-social odors also affect risk-taking decisions. Overman et al. (2011) found that releasing fragrance during the Iowa Gambling Task activated the orbitofrontal cortex in men, making their decisions more emotional, reducing cognitive capacity, and decreasing win rates. In monetary gambling tasks, exposure to aversive odors (methanethiol) increased loss aversion, while pleasant odors (jasmine) did not alter it (Stancak et al., 2015). Building on this work, von Helversen et al. (2020) conducted a risk decision experiment with real consequences: participants who failed a gambling task had to smell a disgusting odor (e.g., fecal smell) but could pay money to avoid it. Results showed participants were willing to pay more to avoid the disgusting odor.

Non-social odors additionally influence consumer decisions. Davis et al. (2013) found that verbal scent descriptions in advertisements created an illusion of actually smelling the scent, significantly affecting consumers' emotional responses and purchase intentions. Leenders et al. (2019) tested three concentrations of melon fragrance in a large store, finding that higher concentrations positively affected shoppers' store evaluations, time spent, and sales volume, while effectively reducing customer anxiety. The match between ambient scent and product also matters. De Luca and Botelho (2020) found that pleasant odors (olfactory priming) increased brand logo recognition speed and improved efficiency of odor-based product categorization compared to visual priming, leading consumers to purchase more products consistent with the primed scent. Appropriate scents in retail environments can induce pleasant shopping experiences and promote brand recall and product selection. Madzharov et al. (2015) investigated how warm (e.g., cinnamon) and cool (e.g., mint) scents relate to spatial perception in shopping environments, finding that warm scents made individuals feel more tense, increased power desire, and led to greater spending on luxury goods. Lefebvre and Biswas (2019) extended this to food consumption, showing that compared to cool ambient scents (e.g., eucalyptus), warm scents (e.g., cedar) led individuals to prefer low-calorie foods. Food odors also promote eating behavior and physiological responses. Proserpio et al. (2017; 2019) found that food odor conditions yielded significantly higher appetite scores than odorless conditions, with high-energy food odors (e.g., chocolate, milk) increasing food intake and salivation. This effect is specific: individuals tend to select foods with similar flavors or energy density to the food odor presented.

1.2 The Influence of Social Olfactory Information on Social Judgment and Decision-Making

Social chemosignals affect how individuals perceive and judge others. Human pheromones can influence emotional perception of potential partners in a sexual orientation-specific manner. For instance, heterosexual women (but not men) who smelled androstadienone rated point-light walkers as happier and more relaxed when they appeared male, while estratetraenol made heterosexual men (but not women) perceive female walkers as happier and more relaxed (Ye et al., 2019). In trust games, investment amounts correlated positively with the pleasantness of the trustee' s body odor, with more pleasant odors receiving higher investments (Lobmaier et al., 2020). Individuals with congenital anosmia experience greater insecurity in intimate relationships, with men showing reduced sexual motivation and women displaying diminished interpersonal trust (Croy et al., 2013). Moreover, the body odors of same-sex friends are more similar than those of randomly paired same-sex individuals (Ravreby et al., 2022), suggesting olfaction may facilitate social bonding and alliance formation through selection of similarly-scented individuals. Gaby and Zayas (2017) found that when participants smelled a particular T-shirt odor, they rated the unknown wearer more positively on friendliness and warmth, and this positive evaluation persisted when they smelled the same person' s odor a second time, indicating stability in judgments based on social olfactory information.

Social odors also influence prosocial behavioral decisions. Infants use olfaction to connect with their environment during vulnerable periods. When exposed to breast milk odor, infants display more prosocial behavior, greater willingness to explore new environments, and increased neural synchrony during interactions with strangers (Endevelt-Shapira et al., 2021). Research using body odors collected from cooperative versus uncooperative men in games found that women were more likely to cooperate when exposed to cooperative men' s scent and actively avoided interaction when exposed to uncooperative men' s scent (Tognetti et al., 2022).

Finally, social odors affect other social decisions. In moral dilemmas, exposure to ambient body odor (with no actual person present) made participants subconsciously sense someone real, causing greater hesitation when deciding to harm others and leading to more deontological moral decisions (Cecchetto et al., 2019). Body odor also influences risk decisions. Haegler et al. (2010) found that compared to sweat from non-risk-takers, sweat from high-risk-takers led participants to choose riskier tasks with lower odds but higher payouts. Meister and Pause (2021) discovered that compared to odorless and exercise sweat conditions, anxiety-state sweat made women more likely to form negative outcome expectations and consequently make less risky decisions.

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2 Five Hypotheses on the Mechanisms of Olfaction' s Influence on Social Decision-Making

Olfaction demonstrably influences social decision-making, yet most empirical research has focused on establishing these effects rather than systematically investigating their underlying mechanisms. This paper synthesizes discussions from various studies and organizes five hypotheses to explain these mechanisms from phylogenetic, physiological, emotional, cognitive, and interpersonal perspectives (see Figure 1 [Figure 1: see original paper]).

2.1 Evolutionary Hypothesis The evolutionary hypothesis posits that olfaction is an "adaptation"that evolved to solve survival and reproduction challenges, enabling humans to infer others' emotions, identify kin and caregivers, and find healthy mates without learning, thereby producing seemingly "instinctual"social judgments and decisions in response to specific odors.

First, olfaction functions as an evolutionary adaptation through "psychological mechanisms"(sets of processing operations) that solve survival and reproduction problems. For human ancestors, determining which foods were nutritious versus toxic was critical. Assessing food through color, aroma, and taste constituted an adaptive mechanism for evaluating nutritional value and safety. In terms of smell, "fragrant" foods were typically nutritious while "foul" ones were inedible or poisonous. Decaying matter and feces harbor bacteria and viruses; through evolution, humans came to perceive their odors as disgusting and automatically avoid them, reducing disease probability. Thus, the "foulness" of decay and excrement is determined not by chemical structure or the nose itself, but by the 利害关系 (cost-benefit relationship) between humans and these substances. Olfaction also helps detect environmental dangers, enabling rapid responses to predators, prey, objects, and terrain (Wilson, 2002).

Second, olfaction influences social judgment and decision-making automatically through these psychological mechanisms. Prokosch et al. (2021) found that sexual disgust mediated the relationship between olfactory acuity and short-term mating tendencies, with individuals having keen olfaction less willing to engage in short-term sexual behavior. Women prefer the body odor of men with dissimilar human leukocyte antigen (HLA) features (Jacob et al., 2002), as mating with HLA-dissimilar partners produces offspring with more diverse immunological profiles and greater adaptive immunity. Individuals can identify kin through body odor to avoid inbreeding (Porter, 1998), likely mediated by the major histocompatibility complex (MHC) gene, which controls immune response. The human olfactory system can decode MHC information (Schaefer et al., 2001), and selecting MHC-dissimilar mates avoids inbreeding—a genetic strategy widespread across species. Miller and Maner (2011) found that fertility-related scent cues in women activated men' s sexual motivation, promoting mate-seeking psychology and behavior, suggesting women may use perfume to enhance feminine characteristics in their body odor to attract mates (Allen et al., 2016). Olfaction is also modulated by factors such as menstrual cycle and

pregnancy, during which women experience heightened olfactory acuity (Olofsson et al., 2005; Pause et al., 1996), potentially serving both mate selection and fetal protection functions. Individuals with autism spectrum disorder struggle to correctly interpret emotional cues in social odors (Endevelt-Shapira et al., 2018), while depression and schizophrenia patients often exhibit olfactory identification deficits (Chen et al., 2019), suggesting that abnormal social cognition may impair olfactory function and that olfactory dysfunction could serve as an early indicator of mental illness.

In summary, the evolutionary hypothesis follows the logic: "olfaction → psychological mechanism as adaptation → social judgment and decision-making." Through continuous evolution, humans use olfaction to identify dangers and select mates, maximizing survival and reproductive success. Foul odors prompt avoidance—for instance, in Barnett et al. (2022), putrescine activated psychological defense mechanisms. Pleasant odors promote approach—for example, Hirsch (1995) found that casino attendance increased when ambient scent was present. As an adaptation for survival and reproduction, olfaction operates automatically through psychological mechanisms, altering judgments and decisions without conscious awareness. Olfactory dysfunction patients show reduced sensitivity to spoiled food but increased disgust toward poor hygiene (Ille et al., 2016).

2.2 Physiological Hypothesis The physiological hypothesis proposes that odor molecules enter the bloodstream through nasal or pulmonary mucosa, affecting the autonomic nervous system, central nervous system, or endocrine system, thereby altering physiological state and arousal levels to influence social judgment and decision-making.

This hypothesis receives substantial empirical support. Haze et al. (2002) found that inhaling essential oils from pepper, mugwort, and fennel increased sympathetic nervous activity by 1.5–2.5 times compared to odorless solvent, while rose and patchouli oils decreased it by 40%. Pepper oil increased plasma adrenaline concentration by 1.7-fold, whereas rose oil decreased it by 30%. Ogata et al. (2020) observed that human participants inhaling lavender odor showed decreased systolic and diastolic blood pressure and reduced scores on the Self-Rating Depression Scale; in mice, lavender inhalation increased intracellular calcium concentration in hypothalamic oxytocin neurons, demonstrating sedative effects across species. This may explain Sellaro et al.' s (2015) findings that lavender made individuals feel more relaxed, reduced vigilance toward others, and increased perceived commonality. Choi et al. (2022) found that jasmine fragrance significantly increased alpha brain waves, indicating a stable, relaxed brain state, which may explain Cook et al.' s (2015) results where jasmine' s pharmacological effects altered brain physiology, inducing a more pleasant mood and higher facial pleasantness ratings.

In summary, the physiological hypothesis follows the logic: "olfaction → physiological state and arousal level → social judgment and decision-making." It

explains olfaction' s social effects from a physiological and pharmacological perspective. However, as Herz (2009) noted, if odor molecules must cross the blood-brain barrier via circulation to exert effects, the process would require at least 20 minutes, yet most studies find immediate effects on emotion and behavior. This temporal discrepancy suggests that the theoretical basis and mechanisms of the physiological hypothesis require further investigation.

2.3 Emotion Induction Hypothesis This hypothesis posits that ambient olfactory stimuli alter emotional states, which subsequently influence social judgment and decision-making.

First, olfaction affects emotion. Neurologically, olfaction has more direct and intimate connections with emotion than other senses. Central neural structures involved in olfactory processing include the amygdala, orbitofrontal cortex (OFC), hippocampus, and insula. The amygdala processes disgust and fear, working with the hippocampus to form emotional memories (Richardson et al., 2004). When smelling strangers' odors, the amygdala activates fear and vigilance circuits, whereas friends' odors do not activate the amygdala (Ravreby et al., 2022). The OFC serves as both an important physiological basis for olfaction and a key neural structure for emotional processing and cognitive decision-making (Bechara et al., 2000). The insula integrates bodily sensory information including olfaction to provide references for emotional state evaluation (Paulus & Stein, 2006). These structures establish the neural foundation for olfaction-emotion interactions. Numerous studies directly demonstrate olfaction' s emotional impact. After sniffing body odors from people in different emotional states (fear, happiness, neutral), participants exhibited distinct facial muscle activity patterns (de Groot et al., 2015; de Groot et al., 2018). When healthy and anosmic groups viewed emotional and neutral pictures, healthy participants showed hippocampal, amygdala, and anterior cingulate activation for emotional pictures, whereas anosmic participants did not, suggesting that olfactory loss may impair emotional processing (Han et al., 2019). Field surveys of car passengers found that pleasant odors increased positive emotions (happiness, calmness, well-being) and travel satisfaction (Silva et al., 2021). Although ambient odors (non-social olfactory information) typically regulate emotion through valence, while human sweat and body odors (social olfactory information) carry inherent social-emotional information with different neural encoding and emotional system effects, both demonstrate that olfaction and emotion are inseparable at neural and behavioral levels (Zhou & Chen, 2012).

After olfaction influences emotion, these emotional changes subsequently affect social judgment and decision-making. Odors possess different emotional valences, and their induced emotional perceptions influence judgments and decisions (Royet et al., 2003). Gambetti and Giusberti (2012) found that trait anger predicted investment in different stock types, with angry individuals perceiving stocks as more predictable and preferring riskier decisions, while trait-anxious individuals saw stocks as less predictable and preferred low-risk portfolios. In-

troverted individuals facing personal moral dilemmas experienced negative emotions, leading to more deontological decisions that prioritize utilitarian outcomes over moral rules (Tao et al., 2020). Rainone et al. (2021) examined emotion' s effect on bias in ethical decision-making, finding that happiness reduced moral bias while sadness increased it compared to neutral affective states. Women perceived less stress when smelling their partner' s odor versus their own or a stranger' s odor (Granqvist et al., 2019; Hofer et al., 2018). Releasing appropriate scents like peppermint in workplaces can enhance alertness, thereby improving work motivation and efficiency (Lwin et al., 2021).

In summary, the emotion induction hypothesis follows the logic: "olfaction → emotion → social judgment and decision-making."Pleasant ambient odors induce positive emotions in women, making them more receptive to men' s courtship requests (Guéguen, 2012b). Disgusting ambient odors induce negative emotions, reducing attractiveness ratings of neutral faces (Cook et al., 2015). Sweat odor from anxious states during risky behavior leads to riskier decisions (Haegler et al., 2010). However, some studies find that anxious individuals' sweat odor makes people feel less happy, reduces trust, and increases risk avoidance (Meister & Pause, 2021). These discrepancies may stem from differences in experimental paradigms and methods of inducing anxiety odors.

2.4 Embodied Cognition Hypothesis The embodied cognition hypothesis proposes that individuals use bodily olfactory experiences as concrete, familiar metaphorical sources to understand social events, thereby influencing social judgments and decisions.

First, people cognize the world through olfactory metaphors. Olfactory metaphors like "fragrant" and "foul" provide important pathways for understanding abstract social events. In Chinese culture, "fragrant" (香) in "流芳百世" refers to noble morality; in "赠人玫瑰, 手有余香," it signifies the moral satisfaction from helping others. "Fragrant" also denotes beautiful women, as in "国色天香" and "怜香惜玉," linking floral fragrance with femininity and rich emotional imagination. Conversely, "foul" (臭) represents despised qualities: "臭名昭著" and "遗臭万年" describe evil or immoral people; "臭脾气" refers to bad temper; "铜臭味" mocks the ignorant wealthy; and in "朱门酒肉臭," "foulness" becomes a symbol of the exploiting class. Olfaction evolved from a natural sense of environmental odors to describing living conditions and ultimately to symbolizing moral status.

Second, embodied cognition affects decision-making. Embodied cognition means physiological experiences activate psychological sensations that influence social decisions. Holland et al. (2005) and Liljenquist (2010) found that citrus cleaning scents increased moral behavior because citrus fruits have strong antibacterial properties and fresh aromas, which embodiedly activated "cleanliness" metaphors, unconsciously leading individuals to hold themselves to "clean" standards and increase moral behavior in decision-making. Lee et al. (2015) found that fishy smells induced suspicion and distrust, increasing

vigilance toward information and prompting more cautious responses. The fishy smell metaphorically represents suspicious or unreliable phenomena, possibly because in English, "suspicion" is highly associated with transactions involving organic, perishable products like fish and meat, which emit foul odors when rotten. Through olfactory experience, people learn to identify problematic foods (Lee et al., 2012), gradually forming metaphorical associations between odor and suspicion.

In summary, the embodied cognition hypothesis follows the logic: "olfaction → embodied cognition and metaphor → social judgment and decision-making." When individuals encounter different odor contexts, olfaction activates corresponding metaphorical mechanisms and cultural norms, potentially altering views of real events and influencing decisions. For example, warm scents (cinnamon) increase power desire and luxury purchasing (Madzharov et al., 2015). Since hunger pairs with cold and satiety with warmth, warm scents during eating create psychological satiety cues, leading to low-calorie food choices (Lefebvre & Biswas, 2019). Odor perception activates odor-related semantic and behavioral representations that automatically guide and modify judgments and decisions in specific contexts.

2.5 Social Construction Hypothesis The social construction hypothesis posits that after odor stimulation, environmental language and sociocultural norms alter individuals' emotional experiences and cognitive meanings of olfaction, influencing social judgment and decision-making outside awareness.

First, olfaction activates environmental language and sociocultural norms. Coppin et al. (2016) found that the scent of famous Swiss chocolate activated Swiss individuals' national identity, whereas popcorn scent did not, and this chocolate scent did not trigger identity in non-Swiss individuals. Wnuk et al. (2017) discovered cultural differences in odor-temperature associations: Thais linked banana scent with cold and cheese/garlic with heat, while Dutch associated alcohol and sand ginger with cold. As temperature perception affects purchasing desire and food choices (Madzharov et al., 2015), culture moderates these effects. Odor identification also correlates highly with language, memory, and general cognitive function. Regression analysis shows language is a significant predictor of olfactory performance (Westervelt et al., 2005). Majid et al. (2018) matched 30 Malaysian indigenous people with 30 Dutch participants, finding similar emotional responses to odors but different descriptive strategies: Dutch used concrete terms (e.g., "lemon scent"), while Malaysian indigenous people used abstract descriptions (e.g., "musty"), possibly because hunter-gatherer lifestyles involve more frequent odor discussion and easier naming. Different national cultures, lifestyles (Olofsson et al., 2018), and family environments affect odor expression, and linguistic differences influence how individuals view odors emotionally (Majid, 2021). Human olfactory perception has transcended pure sensory experience, activating culturally relevant language and norms.

Second, sociocultural factors influence social judgment and decision-making.

Cultural differences between collectivism and individualism matter. Chinese show slightly stronger risk preferences in financial decisions than Americans because Chinese collectivism may provide support that buffers negative consequences of poor decisions (Weber & Hsee, 1998). Individualistic societies show greater donation behavior than collectivistic societies because individualism drives capitalism, increases wealth disparity, and creates expectations for the wealthy to support those in need, thereby promoting prosocial donation decisions (Luria et al., 2014).

In summary, the social construction hypothesis follows the logic: "olfaction → sociocultural construction → social judgment and decision-making." Olfaction activates innate cultural backgrounds that influence decision-making about related events. As Vygotsky argued, all cultural phenomena are social, and odors map onto humans' internal historical experiences and cultural meanings. While most people despise the stench of pickled herring, Swedes cherish it, so when Swedes encounter this odor, its cultural background evokes different cognitions that influence their social judgments.

3.1 Existing Problems

Chemical signals from odors contain rich information. Human olfaction is remarkably sensitive, and substantial evidence demonstrates that both non-social and social odors influence social judgment and decision-making at conscious and subconscious levels. Against the backdrop of burgeoning embodied cognition research in psychology, this represents a promising area, yet several issues persist.

First, individual differences in odor perception exist. Human thoughts and intentions are covert, making social cognition inherently uncertain (FeldmanHall & Shenhav, 2019). Across cultural backgrounds, contexts, and even among individuals in the same situation, emotional expression of disgust, fear, happiness, and sadness varies considerably (Barrett et al., 2019). Unique individual experiences and preferences with odors top-down influence odor cognition, judgment, and decision-making. For example, Allen et al. (2016) found women attend more to olfactory information than men, whereas Sandell (2019) found no gender effect, arguing that olfaction' s influence on decisions is primarily constrained by individual cognitive decision styles.

Second, studies differ in odor dosage, exposure duration, and manipulation methods, with no unified research paradigm in olfactory psychology. Odor concentration and instruction wording affect results. Bradley et al. (2009) used 0.2 ml of lavender scent, finding it reduced anxiety when watching neutral videos but not anxiety-inducing videos, possibly because the concentration was insufficient for high anxiety levels. Schnall et al. (2008) found unpleasant odors caused harsher moral judgments, but Barnett et al. (2022) did not replicate this. The discrepancy may stem from instructions: the former did not men-

tion room odor, while the latter explicitly asked participants to attend to and rate odors. Additionally, odor effects vary with exposure time. Damjanovic et al. (2018) and Syrjänen et al. (2019) both found that pleasant odors initially facilitated happy face identification but slowed it over time, while unpleasant odors initially impaired but later improved identification. This indicates olfactory adaptation may significantly affect results, and ignoring exposure duration could yield contradictory findings.

Third, olfaction is a richly cross-modal sensory domain. In "olfaction-audition" research, odor flow through one nostril affects sound localization only when the trigeminal nerve is activated (Liang et al., 2022). In "olfaction-vision" studies, when different odor concentrations are delivered to each nostril (without trigeminal activation), participants cannot consciously determine which side smells stronger, yet inter-nasal concentration differences bias perceived movement direction of visual optic flow stimuli, subconsciously making participants feel they are moving toward the higher-concentration side, demonstrating olfactory guidance of navigation (Wu et al., 2020). Thus, unlike vision and audition, different olfactory stimuli can influence social cognition both consciously and subconsciously, with subconscious effects potentially stronger than conscious ones (Cecchetto et al., 2017). The natural link between olfaction and emotion is stronger than other senses (Zhou & Chen, 2012), and olfaction can mediate emotional perception even when other sensory signals are ambiguous (Zhou & Chen, 2009). However, because olfaction lacks clear spatiotemporal features, physical properties, and perceptibility like vision and audition, its causal effects are difficult to isolate independently, and existing research has rarely adequately considered cross-modal information integration.

3.2 Future Directions

Psychology has produced substantial empirical research on olfaction' s influence on social decision-making, but these studies generally follow the embodied cognition framework of "bodily sensation of environmental stimuli affecting psychology," constituting basic psychological research. Future work should continue to expand this basic research through improvement and innovation, exploring mechanisms and constructing theoretical models.

First, given olfaction's rich cross-modal nature, future research should adapt and unify experimental paradigms to deeply investigate cross-modal mechanisms with vision, audition, and taste. Syrjänen et al. (2017) observed that odors had smaller effects on emotional evaluation of dynamic versus static faces, possibly because attention focused more on dynamic images. In real-life dynamic interactions, to what extent must olfactory cues integrate with visual cues to produce significant effects? How does "olfactory navigation" coordinate with visual and auditory senses? Is it appropriate for most current experiments to manipulate only olfaction when studying its effects on judgment and decision-

making? Questions about how olfaction integrates with other sensory channels and the relative weight of each modality in task processing urgently require exploration.

Second, research should actively explore localized and cross-cultural mechanisms of olfaction. Odor familiarity affects the universality of odor perception (intensity, irritability, hedonics) or semantics (nameability, familiarity) (Nehmé et al., 2016). Currently, few domestic studies examine olfaction's influence on social life and decision-making in Chinese contexts. Olfactory experiences are culturally specific; investigating olfaction' s role in Chinese cultural contexts while expanding cross-cultural research can better characterize olfaction' s decision-making effects, avoid misinterpreting signals, and promote cross-cultural communication. Additionally, most empirical studies on odor and face evaluation occur in laboratories—can these be extended to real social behavior? Beyond olfactory navigation, can other olfactory processes like odor identification, discrimination, and their relationship with spatial memory be explored? Most literature shows olfactory impairment negatively affects social interaction, but how do different impairment levels affect decision processes? In the psychology of love, how does olfaction influence perception and behavior related to different mating strategies? Although olfactory processes may inhibit short-term mating strategies, might they play important roles in forming and maintaining long-term romantic relationships?

Finally, applied research should develop olfaction' s role in social life, such as consumer psychology. As discussed, appropriate scents in retail environments can induce pleasant shopping experiences, and warm scents increase luxury purchases. Businesses can use scent to promote consumer spending, while hotels, restaurants, and cafes can create unique olfactory atmospheres consistent with brand image to enhance brand recognition, comfort, and pleasure, building brand identity and customer loyalty (Errajaa et al., 2021). In business negotiations, parties' body odors and ambient scents may influence negotiation atmosphere, making it warm or cold, friendly or suspicious. In school moral education, fresh scents like orange might enhance students' moral awareness and promote moral and prosocial decision-making.

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The Effect of Olfaction on Social Judgment and Decision-Making and Its Mechanism

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Abstract: Olfaction is phylogenetically one of the oldest organism adaptations, playing an important role in human survival and development, potentially influencing interpersonal perceptions, moral judgments, prosocial behavior decisions, and consumption preferences, in addition to guiding individuals to avoid potential risks, renders it a topic of substantial research interest. Various hypotheses have been advocated, including the evolutionary, pharmacological, emotion-induced, embodied metaphor, and social construction hypotheses. These hypotheses attempt to elucidate the mechanisms underlying the influence of olfaction on social judgment and decision-making from five perspectives: phylogenetics, body interaction, emotion-induced, cognitive and interpersonal interaction. Extensive research lacks consideration of individual differences in olfactory perception, variability in olfactory manipulation, and integration of olfactory clues with other sensory modalities. These issues can be addressed in a targeted manner in the future, and research related to olfaction can be further explained in fields of cross-modal, localized and cross-cultural, as well as social life applications, such as consumer psychology.

Keywords: olfaction, social judgement, social decision-making, mechanism

Note: Figure translations are in progress. See original paper for figures.