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What are the Odds? How Probability Estimates Influence the Mental Representation of Future Events.

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Abstract

Wakslak, Trope, Liberman and Alony (2006) observed in seven experiments that improbable (vs. probable) events are mentally represented more abstractly (vs. concretely). Despite the lack of replications of this proposed relationship, it is widely accepted and forms the basis for further studies on this topic. Study 1 of the present paper aimed to replicate experiment 1 of the paper by Wakslak et al. (2006). Study 2 aimed to extend those findings by examining whether not only static probability estimates, but also downward (vs. upward) revisions of probability estimates are related to more abstract (vs. more concrete) mental representations. Results did not support the hypotheses of studies 1 and 2. The present paper points out possible limitations of the relationship between probability estimates and mental representations. It highlights the importance of further replication studies to fathom under which circumstances this relationship is present before generalizing results.

Uncertainty is a constant companion in our daily lives. Will the good weather hold up until tomorrow? Will this investment be profitable? Will this job make me happy? Nothing can be predicted with absolute certainty. However, there often is a necessity to make decisions about uncertain events. We need to decide whether to pack our bags and go camping tomorrow, whether to invest in this company or whether to take a job offer. In order to make the best possible decisions about uncertain events, we often rely on probability estimates (e.g., a 75% chance of sunny skies tomorrow). These estimates aid our decision making by providing us with information about how likely a certain future event is, thereby reducing uncertainty. As we are confronted with probability estimates almost every day, our perceptions of and actions upon probability estimates are a relevant research topic.

Research suggests that mental representations of events depend on whether they have a high or a low probability of occurring (Wakslak & Trope, 2009). A camping trip that we are

going to take with a 95% probability will be perceived differently than a camping trip that we are going to take with a 5% probability. We will think about the high probability camping trip more concretely and detailed (e.g., “What am I going to pack?” “How am I going to get to the location?”), while we will think about the low probability camping trip more abstractly (e.g., “Do I want to take this trip?”) (Wakslak, Trope, Liberman & Alony, 2006). How we think about events (how we mentally represent them) is also known as “construal”, as we mentally “construe” the world around us. Mental construals and the theory behind them will only briefly be introduced here but explained in more detail in the next section.

According to Construal Level Theory (CLT; Liberman & Trope, 2008), we can construe the world around us on different levels ranging from a high level of construal (abstract construal) with a focus on global and central features of events, to a low level of construal (concrete construal) with a focus on local and concrete features of events. As high and low levels of construal highlight different features of events, they can therefore lead to different judgements and actions. For example, in a study by Fujita and Han (2009) participants with a higher construal level exerted more self control regarding food choices, than participants with a lower construal level. These results can be explained with a focus on long term goals and global values (e.g., regarding food choices) of participants when having a higher level of construal at the moment of choice. Findings like these highlight the importance of research examining the antecedents of higher vs. lower construal levels.

One of the suggested factors that might influence construal level of an event is the estimated probability of that event. A study by Wakslak et al. (2006) indicates that when estimated probabilities of events are low, participants are more broad and inclusive in their categorization of objects, more successful at abstracting visual information and less successful at identifying details missing within a coherent whole. All of these behaviours indicate a high construal level, where we tend to see the whole picture rather than details. Wakslak et al.

(2006) conclude that lower probability estimates are related to higher, more abstract construal levels, while higher probability estimates are related to lower, more concrete construal levels.

This study is a key paper in the field of construal level, but it lacks replication studies. Recently, two experiments from the paper by Wakslak et al. (2006) were attempted to be replicated (Calderon, Mac Giolla, Ask, Granhag & Kitayama, 2020). For the first experiment the authors used material which was highly similar to the material used in the original study. For the second experiment they used the same material as in the original study. In contrast to the original study, the authors of the replication study did not find a significant relationship between the probability estimate of an event and construal level. This contradictory finding emphasizes the need for further replications of the study by Wakslak et al. (2006) in order to draw conclusions regarding this relationship. The present paper aims to replicate study 1 of the paper by Wakslak et al. (2006). As Wakslak et al. (2006) found in their study, I expect to find a relationship between higher event probability and lower construal level, and between lower event probability and higher construal level. With this replication the present paper contributes to the Construal Level International Multilab Replication (CLIMR)-Project. The CLIMR-Project is a large-scale replication project which aims to replicate key papers underpinning the relationship between psychological distance and construal level. For the project four key papers were selected for replication, one of those being the paper by Wakslak et al. (2006).

The first study of the present paper examines the relationship between probability estimates and construal level. Probability estimates, however, rarely are a static number but rather a subject to revisions. For example, the probability of rain tomorrow could be estimated at 20%. The next day this estimation could be revised to 30%. The second study of the present paper focuses on the relationship between revisions of probability estimates and construal level. A study by Maglio and Polman (2016) suggests that upward revisions to event-probability (e.g., increasing the estimated probability from 20% to 30%) cause an event to feel

closer, than downward revisions (e.g., decreasing the probability from 40% to 30%), despite the final probabilities being the same (30%). This study provides important new insights about how probabilities are perceived. Perceived closeness of an event and construal level are closely linked (Trope & Liberman, 2010). It therefore seems probable that revisions to event-probability not only influence perceived closeness to that event, but also construal level. Study 2 of this paper investigates the relationship between revisions of probability estimates and construal levels, thereby contributing to a better understanding of construal levels. Previous findings suggest that upward revisions (vs. downward revisions) cause an event to feel closer (Maglio & Polman, 2016) and that feelings of closeness (vs. feelings of distance) are associated with a lower construal level (Trope & Liberman, 2010). Based on these findings, I expect to find a relationship between upward revisions of probability estimates and a lower construal level and between downward revisions of probability estimates and a higher construal level.

Construal Level Theory and Probability Perception

As briefly stated above, the theory behind construal levels is called Construal Level Theory (CLT; Liberman & Trope, 2008). CLT states that we form mental construals about people, objects or events (Liberman & Trope, 2008). Those mental construals are detailed and concrete for things we can experience directly, like the sofa we sit on, the bite of pizza in our mouth, the cat on our lap or the emotions we feel in this very moment (Liberman & Trope, 2008). Some things, however, cannot be experienced directly, like the sofa in another room, memories about the cat we once had as a child, plans about our meals for tomorrow or emotions of another individual. As these things do not exist in our here and now, the mental construals we form about them are more abstract (Liberman & Trope, 2008).

Whether we form concrete or abstract construal levels is therefore related to how close or distant from our direct experience something is (Liberman & Trope, 2008). This subjective experience that something is close or distant from the self, here, and now is called

psychological distance (Trope & Liberman, 2010). It increases as something becomes farther removed from one's own direct experience and decreases as something becomes closer to one's direct experience (Kalkstein, Kleiman, Wakslak, Liberman, & Trope, 2016). Psychological distance is constituted of four dimensions: temporal (when; short vs. long), spatial (where; close vs. distant), social (who; in-group vs. out-group) and hypothetical (whether; certainty vs. uncertainty; Trope & Liberman, 2003). We can experience psychological distance on each of those dimensions. A vacation that we are going to take tomorrow feels closer than a vacation that we will take next year (temporal distance). A party that takes place next door feels closer than a party in another country (spatial distance). Our best friend feels closer to us than a stranger we just met at the supermarket (social distance). A job that we are going to get for sure feels closer than a job we might get (hypothetical distance).

Depending on how distant or close something feels, the mental representation (the construal level) of it changes (Liberman & Trope, 2008). According to CLT, distant events, objects or people are represented more abstractly (high-level construal), while close events, objects or people are represented more concretely (low-level construal; Liberman & Trope, 2008). Low-level construals are concrete, and context-dependent mental representations that include subordinate features of events (Liberman & Trope, 2008). High-level construals, in contrast, are abstract, decontextualized and schematic mental representations (Liberman & Trope, 2008). The same target can be represented as a low-level construal (e.g., a cat) or a high-level construal (e.g., an animal; Bar-Anan, Liberman, & Trope, 2006). Construal level, however, is not a dichotomous concept where the representation is either on a high or on a low construal level, but it is a continuum. The above-mentioned cat can be represented on a continuum from a high construal level to a low construal level. It can be represented as an "animal", a "mammal", a "cat", a "European Shorthair" or as "Simba, the neighbours European Shorthair".

The relationship between psychological distance and construal level is bidirectional (Trope & Liberman, 2010). More distant objects will be construed at a higher level and high level construals will bring to mind more distant objects (Trope & Liberman, 2010). This bidirectional relationship is often described with the forest-tree analogy. When you are close to the forest you see the individual trees (close objects are construed at a lower level), while when you are further away you see the forest as a whole (distant objects are construed at a higher level). Likewise, when you want to see the individual trees you intuitively know that you have to move closer to the forest (low level construals bring to mind close objects; Trope & Liberman, 2010).

A possible explanation for the relationship between psychological distance and construal level is the relationship between direct experience and knowledge about an event (Wakslak et al., 2006). When something happens in the here and now, we tend to have a lot of detailed information about it, and therefore think in concrete terms (Wakslak et al., 2006). In contrast, when something occurs in the distant, we tend to have little concrete information about it and form more abstract and schematic representations.

Furthermore, it seems to be more functional to use higher level construals for more psychologically distant objects or events and lower level construals for more psychologically close objects or events, as higher level construals are less likely to change with increasing distance (Soderberg, Callahan, Kochersberger, Amit, & Ledgerwood, 2015). For example, asking someone to “watch Netflix together” only makes sense in a time and location where Netflix exists and for individuals who have a Netflix-account. In contrast, the question to “watch a movie together” retains its meaning across a longer time span, more places and more individuals. This more abstract phrasing comprises many different concrete ideas (e.g., going to the cinema, watching a DVD, or watching a VHS) and therefore does not only obtain its meaning in concrete and proximate contexts, but extends it to more distant ones.

As mentioned above, mental representations influence our decisions and actions. Depending on our level of construal we make different decisions (Trope & Liberman, 2010). For example, studies have found that participants who were induced to have a higher level of construal exerted more self-control (Fujita & Han, 2009; Fujita, Trope, Liberman, & Levin-Sagi, 2006), showed increased risk propensity (Lermer, Streicher, Sachs, Raue, & Frey, 2015), were more likely to procrastinate (McCrea, Liberman, Trope, & Sherman, 2008), were more motivated to attempt a difficult task (Carrera, Fernández, Muñoz, Caballero, & Morrow, 2020), reacted more positively to eco-friendly products (Reczek, Trudel, & White, 2018), showed an increased willingness to save money (Rudzinska-Wojciechowska, 2017), were more motivated to pursue a goal (Davis, Kelley, Kim, Tang, & Hicks, 2016) and were more polite (Stephan, Liberman, & Trope, 2010) than participants who were induced to have a lower level of construal. These wide-ranging effects of construal level on our decisions and actions emphasize the relevance of examining factors that might promote a higher vs. a lower construal level. The present study takes a step in this direction by examining the relationship between psychological distance (induced by higher and lower probability estimates) and higher and lower construal levels.

Probability is considered to be experienced as a dimension of psychological distance (Wakslak et al., 2006). As mentioned above, psychological distance increases as something becomes farther removed from one's direct experience and decreases as something becomes closer to one’s direct experience (Kalkstein et al., 2016). Independent of its spatial, temporal or social distance, something is removed from one’s direct experience when it could have happened but did not happen or when it is probable but not certain (Wakslak et al., 2006). Therefore, an uncertain event will feel more distant than a certain event and the felt distance will increase with increasing uncertainty (Wakslak et al., 2006). For example, going on a camping trip will feel more distant when it is a trip that one could take rather than a trip that one has taken, and the lower the probability of taking that trip, the greater the psychological

distance. The notion of probability as a dimension of psychological distance is, for example, supported by a study by Wakslak (2012) which found that participants expect less probable events to happen in a more remote location and at a later point in time than more probable events. Other authors also suggest a reverse relationship of probability and time by proposing that not only a lower probability makes the event feel to lie further in the future, but also that an event that lies further in the future feels less probable (e.g., Fehr, 2002).

Probability not only affects psychological distance, but also construal level (Wakslak et al., 2006). When something is likely to occur to us, it is likely to become part of our direct experience and thus will be treated more like an event that we experience directly, namely with a concrete mental representation. Something that is unlikely to occur to us is unlikely to become part of our direct experience and thus will be represented more abstractly. Wakslak et al. (2006) conducted seven studies that support this proposition. For example, they found that participants who imagined an improbable event (compared to participants who imagined a probable event) were more broad and inclusive in their categorization of objects, which indicates a higher construal level. The effect of probability distance on construal level mirrors the effects of temporal (Liberman, Sagristano, & Trope, 2002), spatial (Henderson, Fujita, Trope, & Liberman, 2006) and social distance (Liviatan, Trope, & Liberman, 2008) on construal level.

In the way that probability affects construal level, construal level also affects probability judgments. Several studies suggest that forming a lower construal level of an event makes it seem more probable. Sherman, Zehner, Johnson, and Hirt (1983), for example, found that participants who read a detailed description (inducing a low construal level) of a future event, estimated the event-probability to be higher, than participants who read an abstract description (inducing a high construal level) of that event. In line with those results are the findings of Sherman, Cialdini, Schwartzman, and Reynolds (1985) who examined participants' estimated probabilities of contracting a disease. Participants who received

concrete information about the symptoms of the disease (e.g., low energy level, muscle aches, severe headaches) estimated the probability of contracting this disease as greater than participants who received abstract information about the symptoms (e.g., disorientation, malfunctioning nervous system).

As these results indicate, probability estimates of events are closely linked to the context those events are presented in. Independent of construal levels, context information can alter the perception of objective probability estimates. Windschitl and Weber (1999), for example, presented participants with a 5% probability estimate for rain occurring either in Madrid or in London. Even though the objective probability estimate for rain was the same for both cities (5%), participants felt that rain was more likely in (typically rainy) London than in (typically arid) Madrid. Results like this highlight the importance of discriminating between objective and subjective probabilities. The second study of the present paper further examined this discrepancy by investigating how revisions of probability estimates influence the subjective perception of an objective probability estimate. It thereby also reassesses the proposed relationship between probability revisions and psychological distance, as the proposal of this relationship is solely based on one paper, which has not been replicated so far (Maglio & Polman, 2016). This lack of replication studies seems to be a general problem in the field of psychological distance and construal level.

Importance of Replicating the Effect of Probability Distance on Construal Level

Replication studies are an important part of scientific research. The goal of scientific research is to find effects that are true in the population and not a result of mere chance or of Questionable Research Practices (QRPs; John, Loewenstein, & Prelec, 2012). QRPs are different from fraud in the way that those practices can sometimes be used for legitimate purposes. For example, outliers can bias a result and are therefore advised to be excluded before data analysis. Selective exclusion of outliers, however, becomes a QRP (i.e., deciding whether to exclude or not exclude an outlier depending on which of the two helps to produce

a significant result). Further examples of QRPs are deciding whether to collect more data after looking to see whether the results will be significant, selective reporting of variables, selective reporting of studies that worked, or rounding down p-values (John et al., 2012). If a found effect is not a result of QRP or chance but is true in the population, it is more likely to be replicable (Aspendorf, 2013). Many replications in the field of psychology, however, are not successful. The Open Science Collaboration, for example, conducted 100 replications of studies published in three psychological journals and only 36% of those replications yielded significant results (Open Sci. Collab., 2015). Studies on construal level are no exception to this so-called replication crisis.

CLT has become a highly influential theory in social psychology and its relationship with psychological distance has become widely accepted (the review article about psychological distance and CLT by Trope and Liberman, 2010 has received over 2000 citations). A meta-analysis by Soderberg et al. (2015) found a medium effect of psychological distance on construal level. However, this estimate might be exaggerated. Results of a funnel plot, constructed by the authors of the meta-analysis, suggest that the estimated effect was inflated by a publication bias. Furthermore, of the 310 included effects only eight were effects of a probability distance manipulation (Soderberg et al., 2015). Seven of these were from the same paper (Wakslak et al., 2006). Those seven studies had sample sizes ranging from 21 to 95 (M = 43), which, with a power of 80%, would be sufficient to detect a Cohen's d of 0.89, which is a large effect (Cohen, 1988). The studies would not be able to detect small or medium effects, which means that the power of those studies is low. Low powered studies can be a grave problem for scientific research because they are less likely to find an effect that is actually present in the population. The discrepancy between the low probability of obtaining significant results with underpowered studies and the fact that every one of those seven studies of the paper by Wakslak et al. (2006) obtained significant results undermines the

credibility of the reported effects. Replication studies are necessary to further examine the proposed relationship between probability distance and construal level.

Not only studies examining the relationship between probability distance and construal level lack replication, but also studies examining the other dimensions of psychological distance, namely temporal, spatial and social distance. As mentioned before, the CLIMR-Project aims to replicate key papers underpinning the relationship between psychological distance and construal level. For the project four studies were selected which will be replicated by labs in 95 countries across the world. One of those four studies is study 1 of the paper by Wakslak et al. (2006) about the probability dimension of psychological distance and construal level. The present study contributes to this large-scale replication project by also replicating study 1 of the paper by Wakslak et al. (2006). As mentioned above, results of study 1 will be expanded by a second study. Study 2 takes into account that objective probability estimates can be perceived differently depending on the context they are presented in. Study 2 thereby discriminates between objective and subjective probabilities.

Objective and Subjective Probabilities

When individuals are presented with objective probability estimates, those probabilities tend to undergo psychological translation into a subjective feeling of how likely it is for an event to occur. This feeling influences how individuals interpret and act upon probability estimates (Gallistel, Krishan, Liu, Miller, & Latham, 2014; Loewenstein, Weber, Hsee, & Welch, 2001).

A large body of research has studied how probabilities are inferred and has examined the discrepancy between objective probabilities (how probable something *is*) and subjective probabilities (how probable something *feels*). This discrepancy can occur due to multiple mechanisms, like heuristics and biases (e.g., Fischhoff, 1975; Kahneman & Miller, 1986; Lichtenstein, Slovic, Fischhoff, Layman, & Combs, 1978; Tversky & Kahneman, 1973),

mood effects (e.g., Johnson & Tversky, 1983), or framing effects (e.g., Tversky & Koehler, 1994).

An example for a heuristic that can influence our perception of probabilities is the representative heuristic (Tversky & Kahneman, 1982). In Tversky and Kahnemans' (1982) "Linda problem" participants were presented with a short description of a fictional character named Linda. Participants were then asked to make a judgment of the probability of Linda being (a) a bankteller or (b) a bankteller and active in the feminist movement. Participants judged the latter description to be more likely, even though, according to the conjunction rule of probability, the probability of a conjunction, P(A&B), cannot be higher than the probabilities of its constituents, P(A) and P(B). Despite it being mathematically less likely, option (b) seems to be more "representative" of the described Linda and therefore seems to be more probable.

An example for how framing can alter our probability perceptions is shown in a study examining physicians' preferences for lung cancer treatments (McNeil, Pauker, Sox, & Tversky, 1982). Physicians were presented with information about two different treatments for lung cancer: surgery and radiation therapy. According to the 5-year-survival-rate, surgery would be the better option. However, in the short run, surgery is riskier than radiation therapy. Subsequently, half of the participants received information about statistical survival rates shortly after surgery (*"The one-month-survival rate is 90%."*), while the other half received information about statistical mortality rates shortly after surgery (*"In the first month the mortality rate is 10%."*). Afterwards, participants were asked to indicate for which treatment they would decide. Even though both statements are logically equivalent, participants who read about the survival rate chose surgery over radiation more often than participants who read about the mortality rate.

As mentioned above, Maglio and Polman (2016) drew upon findings like these and proposed revisions of probabilities as another context factor that might influence how

objective probabilities are translated into subjective probabilities. In 10 studies, they presented participants with imaginary scenarios containing an initial estimate of probability and a revised estimate. For one group, the revised probability estimate was higher than the initial estimate (upward revision), while for the other group the revised estimate was lower than the initial estimate (downward revision). The final probability estimate, however, was the same for both groups. An example for such a scenario with an upward (and downward) revision is presented below:

> *Initially, scientists estimated that there was a 20% (40%) chance that permanent damage would occur to ocean salinity levels by 2050. However, this estimate was recently revised to a 30% chance.*

Participants who read about the upward revision, indicated that the event of permanent ocean damage felt closer to them, then it did for participants who read about the downward revision. The direction of the revision not only influenced felt closeness of the event, but also participants' decisions related to that event. Participants in the upward revision group subsequently indicated to be willing to pay more money for an eco-friendly product, than participants in the downward revision group (Maglio & Polman, 2016).

One possible explanation for this effect of probability revisions could be psychological momentum, a mechanism that incorporates information about past experiences to form a judgment about future ones.

Psychological Momentum

In physics, momentum describes the phenomenon by which objects in motion do not stop immediately upon application of a resisting force but continue their course for a while (Newton, 1972). This physical momentum has been translated into psychological momentum. Psychological Momentum Theory (PMT) states that past trends are utilized to predict future trends, as trends are expected to continue their course for a while (Markman & Guenther, 2007).

Psychological momentum was first described in the field of sports psychology. Iso-Ahola and Mobily (1980) proposed that players experience a sense of personal "psychological power" after initial success. They operationalized psychological momentum as winning the first game in a best-of-three racquetball match. Iso-Ahola and Mobily (1980) found that players who won the first game were more likely to win the game overall. This effect was also found in tennis. Elite tennis players who won the first set were more likely to win the match (Ransom & Weinberg, 1985). However, evidence for psychological momentum in sports is contradictory. Other studies failed to find a relationship between initial and future success (e.g., Richardson, Adler, & Hankes, 1988; Gilovich, Vallone, & Tversky, 1985). Markman and Guenther (2007) proposed that psychological momentum, irrespective of its relationship to actual success, influences individuals' perceptions, decisions and actions. Individuals expect past trends to continue their course in the future (Markman & Guenther, 2007). Markman and Guenther (2007) further proposed that psychological momentum is not restricted to the field of sports but can be found in various contexts.

Several findings support this proposition. Researchers in visual attention, for example, found that when participants observed a moving point on a screen, which subsequently disappeared, they indicated that the point moved further than it actually did (Freyd & Finke, 1984). Similarly, a glass is more likely to be described as "half full", when it moves from empty to full, than from full to empty (McKenzie & Nelson, 2003). In finance, investors predict rising stocks to rise further and falling stocks to fall further (Hong & Stein, 1999; Jegadeesh & Titman, 1993). Observations like these were also found in the field of psychological distance. For example, regarding temporal psychological distance, a set of studies suggests that the future feels closer than the past, despite the timespan being the same for both instances (e.g., Valentine's Day was perceived to be closer one week before it happened than one week after it happened) (Caruso, Van Boven, Chin, & Ward, 2013). This phenomenon can be explained by psychological momentum. Individuals perceive a direction

of time. Time seems to move from the past to the future. We perceive the distance between the present and the future to be decreasing, while the distance between the present and the past seems to be increasing (this perception of time is, however, different for different cultures; Boroditsky, 2011). We approach the future and leave behind the past and we expect ourselves to continue this trend. Therefore, the future feels closer to us than the past. Similar trends are found for other dimensions of psychological distance. Regarding spatial psychological distance, locations feel closer in space when people are oriented towards them rather than away from them (Maglio & Polman, 2014). Regarding social psychological distance, people attribute more status to employees who have moved upward (rather than downward) in the status hierarchy, despite the ultimate ranks in the hierarchy being the same (Pettit, Sivanathan, Gladstone, & Carson Marr, 2013). Lastly, regarding probability psychological distance, an event which probability of occurring has been revised upward feels closer, than an event which probability has been revised downward, despite the final probabilities being the same (Maglio & Polman, 2016). The second study of the present paper builds upon the findings of Maglio and Polman (2016) by examining the relationship between probability revisions and construal level.

Overview of the Studies

For the present paper two studies were conducted to examine the relationship between probability and construal level. Study 1 of the present paper was a close replication of study 1 of a paper by Wakslak et al. (2006). It aimed to examine whether events with a higher probability are represented at a lower construal level than events with a lower probability. To examine this possible relationship, perceived event-probability has been manipulated via a reading task and construal level has subsequently been examined using a categorisation task. The reading task consisted of descriptions of high probability events for one group of participants and low probability events for the other group of participants. After each event description, both groups of participants received the same list of items related to that event

and were asked to form categories with those items. Participants were free to choose, how many categories they want to form. Fewer and broader categories are associated with abstract thinking and a higher level of construal while more and narrower categories are associated with concrete thinking and a lower level of construal (Lieberman et al., 2002). In accordance with CLT and with the results of the original study by Wakslak et al. (2006), it is expected that there is a relationship between higher probability estimates and lower construal level and between lower probability estimates and higher construal level. This leads to the hypothesis for study 1 of the present paper:

> *Hypothesis 1:* Participants who read about high probability estimates build more categories in the categorisation task, than participants who read about low probability estimates.

Study 2 aimed to extend the findings of study 1 by taking into account that probability estimates are rarely stable. They tend to undergo revisions as more information about the event becomes available. Study 2, therefore, examined the relationship between revisions of probability estimates and construal level. The basic structure of study 2 was the same as in study 1. Participants read scenarios about future events and subsequently were asked to categorize lists of items. Unlike in study 1, in study 2 the final estimates of event probability were the same for both groups of participants. Instead, the two groups differed in whether an upward or a downward revision was proceeding this final probability estimate. The hypothesis for study 2 was based on PMT proposing that past trends are utilized to predict future trends (Markman & Guenther, 2007), thereby suggesting that probability estimates that have been revised upward will be expected to continue being revised upward and probability estimates that have been revised downward to continue being revised downward. In line with this theory are results of the study on probability revisions by Maglio and Polman (2016). Their results suggest that upward revisions to event-probability cause an event to be perceived closer than downward revisions, despite the final event-probabilities being the same. This indicates that

participants expect an event-probability that has been revised upward to continue being revised upward and therefore becoming more probable and less distant than an event-probability of the same size that has been revised downward. In line with these results and with CLT, I expected that events which probabilities have been revised upward are represented at a lower construal level than events which probabilities have been revised downward. This leads to the second hypothesis of the present paper:

> *Hypothesis 2:* Participants who read about upward revisions to probability estimates build more categories in a categorization task, than participants who read about downward revisions to probability estimates.

Study 1: Probability Distance and Construal Level (Replication)

The aim of study 1 was to examine whether high probability events are represented at a lower construal level than low probability events. To test this, participants were split into two groups and read about future events that had a 95% probability to occur (high probability condition) or a 95% probability to not occur (low probability condition). After each scenario, both groups were presented with a list of items related to that scenario and were asked to categorize those items. The categorization task served as a measure of participants' level of construal. Participants were free to decide how many categories they wanted to form with the given items. For example, the items banana, carrot, soda, apple juice and broccoli could all be placed in one category (“nourishments”). However, a participant might also split the items into two categories (“foods” and “beverages”) or into three categories (“fruits”, “vegetables” and “beverages”). As mentioned above, fewer and broader categories are associated with abstract thinking and a higher level of construal while more and narrower categories are associated with concrete thinking and a lower level of construal (Lieberman et al., 2002). It was hypothesised that participants who read about high probability events have a lower construal level and therefore build more categories than participants who read about low probability events.

The probability-scenarios as well as the list of items were directly taken from the original study by Wakslak et al. (2006). A few adjustments had to be made, as the sample of the present study was from Austria and Germany and not, like in the original study, from New York. Scenarios and items were translated from English to German, locations related to New York got replaced by universally valid location descriptions (e.g., "your hometown") or by locations related to Vienna (exact changes are presented further below).

Method

Participants. The sample consisted of 71 participants from Austria and Germany, aged 20 to 76 (M = 32.59, SD = 12.6) with 62% being female. Of those 71 participants 37 were randomly assigned to the high probability condition and 34 were assigned to the low probability condition. Participants were acquired through snowball sampling and through distributing the study link on various social media platforms (i.e., Facebook, PollPool, SurveyCircle and Reddit).

Sample size calculations using G*Power were based on a small effect found by Wakslak et al. (2006) and suggest a sample size of 100 for $\alpha = 0.05$ and power = 80%. Unfortunately, due to the Covid-19 restrictions in Austria during data collection, a lab study using a university participant pool could not be conducted. Instead, participants had to be acquired via social media platforms, which considerably aggravated data collection. Therefore, the calculated sample size could not have been obtained for the current study.

Initially 118 participants have been recruited for this study. Some participants had to be excluded for not finishing the study (29), not answering all four comprehension checks correctly (14), not agreeing to the form of consent (2), having insufficient German skills (1) or being under the age of 18 (1). After exclusion, there were 71 participants left for data analysis. The number of participants in study 1, thus, was lower than the calculated sample size.

Materials and procedure. Before data collection, the present study was pre-registered and an ethics approval was obtained from the Institutional Review Board (IRB) of the University of Vienna (IRB number: 2020/S/014).

Form of consent. Prior to participation participants received information about the procedure of the study. They read that they would take part in a study investigating how objects, people and events are perceived. They further read that they would be presented with imaginary scenarios, followed by lists of items which they had to categorize into groups.

Participants were told that their participation is voluntary and that they were free to leave any time. Furthermore, they were told that participation is anonymous and that their data would be used exclusively for the purpose of the study. Before beginning with the study, participants were asked for written consent for participation. After completion of the study, participants were debriefed with regards to the purpose of the study.

Collection of demographic data. After agreeing to the form of consent, participants were asked about the following demographic data: Age, gender, level of education and German skills. People not eligible for participation (i.e., people under the age of 18 or with insufficient German skills) were notified that they did not fulfil the requirements to participate and did not proceed to the main study. All participants that were not screened out were directed to the main part of the study.

Manipulation of psychological distance. Psychological distance was manipulated via perceived probability of an event. Participants were randomly assigned to the high probability condition or to the low probability condition. They read descriptions of four different scenarios. For the high probability condition all scenarios were almost certain to occur, while for the low probability condition all scenarios were almost certain not to occur. The order of the scenarios was randomized to minimize order effects. The scenarios were the same as in the original study by Wakslak et al. (2006) who adapted them from Liberman et al. (2002). For the current study with a sample from Austria and Germany, the scenarios were

independently translated from English to German using back-to-back translation. Additionally, the cities “New York” and “Boston” were changed into “your hometown” and “a city that is 300km away”. The scenarios for the high likelihood condition (and for the low likelihood condition) are presented in Table 1.

Assessment of construal level. Construal level of participants was assessed using a categorization task. Below each scenario participants were presented with a list of 38 items that were related to the described scenario. They were asked to put items from the list on the left side of the screen into boxes on the right side of the screen. Items that belong together should be placed into the same box. There were 14 empty boxes that could be used. Participants were told that they could use as many boxes as they liked.

Like the scenarios, the lists of items were taken from the original study by Wakslak et al. (2006) and translated to German. One of those original item lists contained items related to New York. Those items were changed into items related to Vienna. The item lists are presented in Table 2.

Comprehension check. To check whether participants read the scenarios mindfully, they completed a comprehension check for each of the four scenarios. For each scenario, participants had to indicate whether the event they read about before was very likely or very unlikely to occur. Participants who did not answer all four comprehension checks correctly were excluded from further analyses.

Manipulation check. To assess if reading the imaginary scenarios really did manipulate psychological distance, participants filled out manipulation check questions. On a 7-point Likert scale ranging from 1 (*very close*) to 7 (*very distant*) participants indicated how close each of the scenarios felt to them.

Table 1

Scenarios for the High Likelihood Condition (and for the Low Likelihood Condition)

Visit scenario	Imagine that a friend of yours made plans to visit the city one weekend. Three days before her planned trip you speak to her and find out that she is just getting over the flu. Although she has been sick, she is 95% positive that she will be all better by the weekend (She is 95% positive that she will still be sick by the weekend). She lets you know she is almost certain to come (not to come) on her planned trip.
Camping scenario	Imagine that you are planning to go with friends on a camping trip, assuming the weather cooperates. You check the weather forecast and find out there is a 95% chance of sunny skies (a 95% chance of rain) for the days of the scheduled trip - which means you will almost certainly go (not go) on the trip.
Moving scenario	Imagine that you have applied for a job with a company that has offices in your hometown and in a city that is 300km away. If you get the job in the office of the 300km away city you will relocate. A friend of yours works at the firm. He tells you that he hears they are almost certain to offer you a job in the 300km away city (offer you a job in your hometown). Looks like you will probably (probably not) be moving.
Yard sale scenario	Imagine that you are moving out of town and decide to have a yard sale to get rid of some of your old stuff. The only large enough space for the sale that you can think of is your friend's backyard. When you ask your friend to use her space, she says she is 95% sure that she does not need (that she needs) her backyard that day and you can probably use it (you probably can't use it). Looks like you probably will be able (not be able) to have the sale.

Table 2

List of Items for each Scenario

Visit Scenario	Camping Scenario	Moving Scenario	Yard Sale Scenario
Reichsbrücke	Brush	Desk	Chairs
Wiener Staatsoper	Tent	Web camera	Rollerblades
Donaustadt	Matches	Pets	Sweaters
Wiener Stadthalle	Camera	Blinds	Crib
Wiener Philharmoniker	Soap	Computer	Candy dish
Parlament	Gloves	Pictures	Fish tank
Nordbahnbrücke	Bathing suit	Coats	Board games
Zentralfriedhof	Shovel	Wi-Fi router	Blender
Schloss Schönbrunn	Fishing pole	Paintings	Bikes
KHM	Hat	Blender	Coats
Raimundtheater	Snorkel	Refrigerator magnets	Dumbbells
Karlskirche	Shirts	Stereo	Infant clothes
Ernst-Happel-Stadion	Sweater	Shirts	Books
Leopold Museum	Sneakers	Silverware	Coffeemaker
Alsergrund	Coat	Bed	Puzzles
Tanz der Vampire	Raft	Musical instrument	Plates
Tiergarten Schönbrunn	Dog	Spatula	CDs
Wiener Stadtpark	Boots	Tapestries	Toaster
Margareten	Marshmallows	Jewellery	Toys
Mariahilfer Straße	Sunglasses	Plants	Cutlery
Donauinsel	Rifle	Tables	Shoes
Museumsquartier	Socks	Letters	Skis
Naschmarkt	Blanket	Underwear	Chess set
Die Zauberflöte	Flashlight	Records	Bird cage
Hotel Sacher	Pants	Wok	Ties
Wiener Prater	Shoes	Mobile phone charger	Baseball cards
NHM	Cigarettes	Posters	Picture frames
Generali Arena	Rope	Microwave oven	Juicer
Schloss Belvedere	Hot dogs	Dresser	Ceramic figurines
Albertina Museum	Canteen	Rugs	Glassware
Meidling	Toothbrush	Dinner plates	Boots

Note. KHM = Kunsthistorisches Museum, NHM = Naturhistorisches Museum.

(continued)

Table 2 (continued)

List of Items for each Scenario

Visit Scenario	Camping Scenario	Moving Scenario	Yard Sale Scenario
Stephansdom	Underwear	Printer	Dolls
mumok	Beer	Photo album	Clock
Hofburg	Sleeping bag	Pants	Records
Volksgarten	Pillow	TV	T-shirts
Wiener Konzerthaus	Insect repellent	Tools	Lamps
Donaustadtbrücke	Potato chips	Shelves	Skateboards
Spanische Hofreitschule	Axe	Alarm clock	Paint brushes

Note. mumok = Museum moderner Kunst.

Assessment of mood. Participants then completed the Positive and Negative Affect Scale (PANAS; Watson, Clark & Tellegen, 1988) to control for mood. Positive mood has been linked to broader and more global processing (e.g., Gasper & Clore, 2002). The probability manipulation might affect mood and subsequently cause mood to drive changes in construal level, rather than probability itself. The PANAS scale consists of 20 items describing different emotions. Participants were asked to indicate, on a scale ranging from 1 (*not at all*) to 5 (*extremely*), the intensity with which they experience each of the emotions at the current moment.

Assessment of task involvement. To assess whether participants in the high probability condition were more involved in the task than participants in the low probability condition, an attentiveness scale was formed. It consisted of three items from the PANAS scale that were proposed to fall on an attentiveness factor: attentive, alert and determined.

Assessment of motivation. Lastly, participants answered three questions assessing how motivated they were to complete the categorization task, how important this task felt to them and how difficult they found the task.

Results

The number of categories formed for each scenario was counted and a mixed ANOVA was conducted, with scenario as a within-subject factor and probability condition as a between-subject factor. The number of formed categories was normally distributed, except for the visit-scenario of the high probability condition. However, as every group consisted of more than 30 participants, this violation of normal distribution could be neglected. Mauchly's test indicated a violation of the sphericity assumption, $\chi^2(5) = 13.54$, $p = 0.019$. To correct for violations of sphericity ($\varepsilon = 0.94$), Huynh-Feldt corrected results are reported.

To check if the manipulation of psychological distance was successful, as well as to control for mood, attention and motivation, t-tests were conducted. Violations of normal distribution could again be neglected, as every group consisted of more than 30 participants.

The difference of number of formed categories between the high ($M = 7.97$, $SD = 2.72$) and the low ($M = 7.77$, $SD = 2.55$) probability condition was not significant, $F(1, 69) = .167$, $p = .685$. Even though the difference was not significant, there was a slight tendency for participants in the high probability condition to form more categories than participants in the low probability condition for the camping-, moving- and yard sale-scenarios. This tendency was reversed for the visit-scenario (see Table 3). Furthermore, there was a significant effect of scenario, indicating that the number of formed categories significantly differed between scenarios, $F(2.831, 184.399) = 4.920$, $p = .003$. Bonferroni-adjusted post-hoc tests revealed that in the moving-scenario there were significantly more categories formed, than in the camping- or yard sale-scenario.

Results of the manipulation check indicated that reading about high or low probability scenarios successfully manipulated psychological distance. The events from the imaginary scenarios felt closer to participants who read about high probability scenarios ($M = 2.86$, $SD = 0.94$) than to participants who read about low probability scenarios ($M = 4.52$, $SD = 1.62$), $t(52.144) = -5.217$, $p < .000$.

Table 3

Means (and Standard Deviations) of Formed Categories for each Scenario and Probability Condition

	Camping	Moving	Yard sale	Visit
High Prob.	7.76 (2.51)	8.70 (2.54)	7.67 (2.59)	7.76 (3.23)
Low Prob.	7.29 (2.07)	8.47 (2.46)	7.32 (2.68)	8.00 (2.99)
Total	7.54 (2.30)	8.59 (2.49)	7.51 (2.62)	7.87 (3.10)

Note. High Prob. = high probability condition, Low Prob. = low probability condition.

To control for possible effects of mood, participants' responses to the PANAS scale were examined. After constructing positive (α = .84) and negative (α = .87) mood scales, a t-test was conducted. Results revealed that there was no difference in positive mood (p = .105) between the high (M = 3.15, SD = 0.70) and low (M = 2.88, SD = 0.68) probability condition and no difference in negative mood (p = .610) between the high (M = 1.68, SD = 0.66) and low (M = 1.76, SD = 0.80) probability condition. To examine possible differences in task involvement between groups, an attentiveness scale was formed (α = .60), using three items of the PANAS scale that fall on an attentiveness factor: attentive, alert and determined. A t-test revealed that there was no difference in attentiveness between the high (M = 3.50, SD = 0.76) and low (M = 3.40, SD = 0.79) probability condition, p = .613.

Furthermore, there were no significant differences regarding motivation to complete the categorisation task between the high (M = 3.49, SD = 0.96) and low (M = 3.52, SD = 1.02) probability condition, p = .856, perceived importance of the task between the high (M = 3.43, SD = 0.92) and low (M = 3.50, SD = 1.02) probability condition, p = .772, and perceived difficulty of the task between the high (M = 2.35, SD = 1.01) and low (M = 2.24, SD = 0.99) probability condition, p = .625.

Discussion

The present study was aiming to replicate a study by Wakslak et al. (2006), who found that participants who read imaginary scenarios about events with a high probability of

occurring (compared to events with a low probability of occurring) subsequently formed more categories in a categorization task. Those results suggest that when thinking about probable events, construal level is lower and more concrete, than when thinking about improbable events. The replication of these results, however, was unsuccessful. Contrary to expectations, there was no significant difference in formed categories between participants who read about high probability-events and participants who read about low probability-events.

There are multiple factors that might have contributed to the unsuccessful replication, only one of which is the possibility that the results of the original study were false positives. Therefore, when interpreting the present study, it is important to take other factors into consideration. First of all, the calculated sample size, necessary to find an effect, could not have been reached for the current study. It might be possible that with a large enough sample, an effect could have been found.

Secondly, even though the present study was a close replication of the original study, there were multiple differences between the two studies. Unlike the original study, the current study was not conducted in a lab, but online. Online studies have some disadvantages compared to lab studies. In online studies many confounding variables cannot be controlled for. Participants might not have used a computer mouse, which makes the categorization task more effortful, they might have been distracted while filling out the study or they might not have paid as much attention to the study and to reading instructions carefully. Additionally, filling out studies online compared to filling them out in a lab can manipulate psychological distance. Darke, Brady, Benedicktus and Wilson (2016) examined the differences in psychological distance between retailers that only have an online shop (virtual retailers) and retailers that have an online shop in addition to their physical facility (hybrid retailers). They found that even a distant hybrid (1.500 miles away) felt closer than a virtual retailer. Findings like this indicate that virtuality increases psychological distance. The fact that the present study was conducted online instead of in a lab might have unintentionally influenced

participants' psychological distance. Other differences between the original and the present study were the country of data collection (USA vs. Austria and Germany), the heterogeneity of the sample (students vs. participants of all ages and occupations) and the time of data collection (2006 vs. 2021). All of those factors can contribute to the discrepancy between the results of the original and the present study.

Thirdly, there might have been systematic differences between participants, possibly overriding the effect of differences caused by the manipulation of event-probability. Participants differed regarding their proximity to Vienna. This difference could have been relevant in the visit-scenario which involved a categorization task with sights of Vienna. The items about sights of Vienna might have manipulated participants' spatial psychological distance by reducing spatial psychological distance for people who live in or close to Vienna and increasing spatial psychological distance for people who live further away from Vienna. This manipulation of spatial psychological distance might have influenced the manipulation of probability distance, as perceived spatial distance can lead to a feeling of uncertainty (Glaser, Lewandowski & Düsing, 2015). Thus, participants living within close proximity to Vienna might have perceived less uncertainty and therefore less probability distance regarding the event, than participants living further away from Vienna, irrespective of the event-probability stated in the scenario. Another consequence of participants' proximity to Vienna is their knowledge about sights of Vienna. The items of the other scenarios consisted of generally well-known objects (e.g., desk, brush, camera, board games), the items of the visit-scenario consisted of sights in Vienna (e.g., Schloss Schönbrunn, Generali Arena, Wiener Staatsoper). Participants from Germany might not be as familiar with Vienna as participants from Austria. This possible unfamiliarity with the items might have influenced the forming of categories, as participants might have been unsure about the meaning of items and hence unsure in which category to put them. Those effects of participants' proximity to Vienna are a possible explanation for the observation that in the visit-scenario the expected effect of

probability on formed categories was reversed (i.e., there was a slight tendency of participants of the low probability condition to form more categories than participants of the high probability condition). Another individual difference between participants that might have influenced their number of formed categories was the use or the non-use of a computer mouse for filling out the study. Without a mouse the categorization of items was considerably more effortful. It was not possible to hold an item and at the same time scroll down to drop it into further down categories. Participants therefore had to first drop the item in a different category to then scroll down, pick up the item again and put it into the desired category. As this process was very effortful, participants without a mouse (compared to participants with a mouse) might have used less categories that were further down and hence less categories altogether.

An additional discrepancy between results of the original and the present study was the overall number of formed categories. In the present study the number of formed categories was generally higher ($M = 7.87$, $SD = 2.63$) than in the original study ($M = 6.54$, $SD = 1.85$). This might be due to the fact that in the original study participants were instructed to form as many categories as they like, while in the present study participants were instructed to use as many of the pre-existing empty boxes as they like. In the original study there was no reference for the possible number of formed categories. In the present study, however, there were 14 pre-existing empty boxes, which might have served as a reference point for the appropriate number of categories, possibly influencing participants to form more categories than they would have without pre-existing boxes (as described in the anchoring effect by Tversky and Kahneman, 1974).

In summary, it can be said that there were three main factors possibly explaining the unsuccessful replication of the original study: (a) a sample below the calculated size, (b) differences between the original study and the present study, like conduction in a lab vs.

conduction online, and (c) possible systematic differences between participants, like their proximity to Vienna or their usage of a computer mouse.

Study 1 examined possible differences in construal level depending on whether an imaginary event is estimated to be probable or improbable to occur. Study 2 extended the findings of study 1 by taking into account that estimated probabilities are likely to be revised over time. Study 2 therefore examined the relationship between revisions of probability estimates and construal level.

Study 2: Probability-Revisions and Construal Level

The aim of study 2 was to examine whether events which probabilities have been revised upward are represented at a lower construal level than events which probabilities have been revised downward. To test this, participants were split into two groups and read scenarios about future events that had a 90% (upward revision condition) or a 100% (downward revision condition) probability to occur. Those probabilities subsequently were revised to 95%. As in study 1, after each scenario, participants were presented with a list of items related to that scenario and were asked to categorize those items.

It was hypothesised that participants who read about upward revisions to event probability have a lower construal level and therefore build more categories than participants who read about downward revisions to event probability.

Method

Participants. The sample consisted of 106 participants, aged 18 to 44 (M = 22.48, SD = 3.81) with 67% being female. 88.7% of participants were from Austria, 11.3% were from Germany. Of those 106 participants 57 were randomly assigned to the upward revision condition and 49 were assigned to the downward revision condition. The majority of participants (91) were acquired through the Laboratory Administration for Behavioral Sciences (LABS) - system of the University of Vienna. Participants received course credits in exchange for participation. The remaining participants (15) were acquired through distributing

the study link in Facebook groups. Sample size calculations using G*Power were based on a small effect found by Wakslak et al. (2006) and suggest a sample size of 100 for $\alpha = 0.05$ and power = 80%.

Initially 118 participants have been recruited for study 2. Some participants had to be excluded for not answering all four comprehension checks correctly (9) and for not finishing the study (3). After exclusion, there were 106 participants left for data analysis.

Materials and procedure. As in study 1, the present study was pre-registered and an ethics approval was obtained from the Institutional Review Board (IRB) of the University of Vienna (IRB number: 2020/S/014). Form of consent, study information and collection of demographic data were identical to study 1.

Manipulation of psychological distance. Like in study 1, psychological distance was manipulated via perceived probability of an event. Perceived probability was in turn manipulated via a reading task containing four imaginary scenarios of events with estimated probabilities of occurring and a subsequent revision of that estimate. Participants were randomly assigned to the upward or the downward revision condition. For the upward revision condition the initial probability estimate (90%) was revised upward, while for the downward revision condition the initial probability estimate (100%) was revised downward. After revision, both groups were presented with a final estimate of event-probability of 95%.

The imaginary scenarios were again taken from the reading task used in the study by Wakslak et al. (2006). They were translated to German and altered to include a probability revision. The scenarios for the upward revision condition (and for the downward revision condition) are presented in Table 4.

Assessment of construal level. Construal level of participants was assessed using the categorisation task described in study 1. The lists of items were identical to the ones used in study 1.

Table 4

Scenarios for the Upward Revision Condition (and for the Downward Revision Condition)

Visit scenario	Imagine that a friend of yours made plans to visit the city one weekend. Three days before her planned trip you speak to her and find out that she is just getting over the flu. Although she has been sick, she is 90% (100%) positive that she will be all better by the weekend. The next day she revises her estimation and lets you know that she is 95% positive that she will be better by the weekend.
Camping scenario	Imagine that you are planning to go with friends on a camping trip, assuming the weather cooperates. You check the weather forecast and find out there is a 90% (100%) chance of sunny skies for the days of the scheduled trip. The next day you check the forecast again and find out there now is a 95% chance of sunny skies.
Moving scenario	Imagine that you have applied for a job with a company that has offices in Boston and in your hometown. If you get the job in the Boston office you will relocate. A friend of yours works at the firm. He tells you that he hears they are 90% (100%) certain to offer you a job in Boston. The next day he revises his estimation and lets you know that they are 95% certain to offer you the job.
Yard sale scenario	Imagine that you are moving out of town and decide to have a yard sale to get rid of some of your old stuff. The only large enough space for the sale that you can think of is your friend's backyard. When you ask your friend to use her space she says she is 90% (100%) sure that she does not need her backyard that day. The next day she revises her estimation and lets you know that she is 95% sure that she does not need her backyard that day.

After completing all four categorization tasks, participants were asked to fill out comprehension checks, manipulation checks, the PANAS scale and questions to assess motivation. All of those were identical to study 1.

Results

As in study 1, the number of categories formed for each scenario have been counted and a mixed ANOVA has been conducted, with scenario as a within-subject factor and probability condition as a between-subject factor. The number of formed categories was normally distributed, except for the yard sale- and camping-scenarios of the upward revision condition. However, as every group consisted of more than 30 participants, this violation of normal distribution could be neglected. Mauchly's test indicated a violation of the sphericity assumption, $\chi^2(5) = 47.64$, $p < 0.001$. To correct for violations of sphericity ($\varepsilon = 0.75$), Greenhouse-Geisser corrected results are reported.

To check if the manipulation of psychological distance was successful, as well as to control for mood, attention and motivation, t-tests were conducted. Violations of normal distribution could again be neglected, as every group consisted of more than 30 participants.

Results of the manipulation check indicated that reading about upward or downward revisions did not manipulate psychological distance. The events from the imaginary scenarios did not feel closer to participants who read about upward revisions ($M = 3.18$, $SD = 1.12$) than to participants who read about downward revisions ($M = 3.19$, $SD = 0.96$), $t(104) = -0.02$, $p = .982$. Furthermore, the difference of number of formed categories between the upward ($M = 7.73$, $SD = 2.36$) and downward ($M = 8.06$, $SD = 2.50$) revision condition was not significant, $F(1, 104) = .709$, $p = .402$. Contrary to expectations, there was a slight tendency for participants in the upward revision condition to form less categories than participants in the downward revision condition (see Table 5). There was a significant effect of scenario, indicating that the number of formed categories differed between the scenarios, $F(2.250, 234.008) = 8.622$, $p < .001$. Bonferroni-adjusted post-hoc tests revealed that in the moving-

and visit-scenario there were significantly more categories formed, than in the camping- or yard sale-scenario.

Table 5

Means (and Standard Deviations) of Formed Categories for each Scenario and Revision Condition

	Camping	Moving	Yard sale	Visit
Upward R.	7.30 (2.14)	8.11 (2.28)	7.32 (2.28)	8.21 (2.74)
Downward R.	7.51 (2.19)	8.39 (2.53)	7.84 (2.31)	8.49 (2.97)
Total	7.40 (2.15)	8.24 (2.39)	7.56 (2.30)	8.34 (2.84)

Note. Upward R. = upward revision condition, Downward R. = downward revision condition.

To control for possible effects of mood, participants' responses to the PANAS scale were examined. After constructing positive ($\alpha = .86$) and negative ($\alpha = .83$) mood scales, a t-test was conducted. Results revealed that there was no difference in positive mood ($p = .803$) between the upward ($M = 2.83$, $SD = 0.66$) and downward ($M = 2.80$, $SD = 0.71$) revision condition and no difference in negative mood ($p = .669$) between the upward ($M = 1.43$, $SD = 0.48$) and downward ($M = 1.48$, $SD = 0.53$) revision condition.

To examine possible differences in task involvement between groups, an attentiveness scale was formed ($\alpha = .62$), using three items of the PANAS scale that fall on an attentiveness factor: attentive, alert and determined. A t-test revealed that there were no differences in attentiveness between the upward ($M = 3.26$, $SD = 0.71$) and downward ($M = 3.22$, $SD = 0.80$) revision condition, $p = .758$.

Furthermore, there were no significant differences regarding motivation to complete the categorization task between the upward ($M = 3.49$, $SD = 0.83$) and downward ($M = 3.61$, $SD = 0.93$) revision condition, $p = .480$, perceived importance of the task between the upward ($M = 3.49$, $SD = 0.87$) and downward ($M = 3.82$, $SD = 0.97$) revision condition, $p = .072$, and

perceived difficulty of the task between the upward (M = 2.21, SD = 0.70) and downward (M = 2.14, SD = 0.79) revision condition, p = .641.

Discussion

The present study was aiming to examine the relationship between revisions of probability estimates and construal level. It was expected that upward revisions of probability estimates are related to a lower construal level and downward revisions of probability estimates are related to a higher construal level. This relationship was not observed in the present study. There was no difference in construal level between the upward and the downward revision conditions. One explanation for this result is the unsuccessful manipulation of psychological distance in the present study. Reading about an upward revision to event-probability, compared to a downward revision to event-probability did not affect perceived closeness (psychological distance) to that event.

One possible explanation for the unsuccessful manipulation is the small revision size of 5% used in the current study (revisions from 90%/ 100% to 95%). PMT suggests that bigger velocity fosters greater momentum (Markman & Guenther, 2007). In the context of probability revisions this would mean that a bigger revision size would foster a bigger difference in psychological distance between upward and downward revision conditions. Maglio and Polman (2016), however, found that the effect of probability revisions on psychological distance was robust across revision sizes of 30%, 20%, 10% and 5%, suggesting that the failed manipulation of psychological distance of the present study might be due to different reasons than small revision size.

Another possible explanation for the unsuccessful manipulation is the overall size of the final probability estimate. All final probability estimates used in the four experiments examining probability revisions and psychological distance by Maglio and Polman (2016) were below 50%, while the final probability estimate used in the present study was at 95%. It is possible that revisions of very high probabilities are perceived differently than revisions of

lower probabilities. Psychological momentum is bound to peoples' belief that a trend will continue its course. In the context of probability revisions, psychological momentum is bound to peoples' belief that after the first revision, the probability estimate will be revised again in the same direction. If participants are led to believe that after the first revision there will be no further revisions, the effect of upward and downward revisions on psychological distance is no longer observable (Maglio & Polman, 2016). For very high probabilities (e.g., 95%) the room for further upward revisions is considerably small compared to the room for further downward revisions (as a probability cannot be higher than 100%). Hence, psychological momentum might be relatively small for people in the upward revision condition. This could lead to a diminished difference of psychological distance between the upward and downward revision condition. However, further studies are necessary to test this assumption and to gain a better understanding of psychological momentum in the context of high probabilities.

A third possible explanation for the unsuccessful manipulation of the present study could lie in the presentation of the imaginary scenarios. In one of their experiments Maglio and Polman (2016) presented participants with the probability estimate of rain and subsequently asked them how close of a chance they think there is for rain (the other experiments were presented in the same manner). In one of the scenarios of the present study participants were presented with the probability estimate of sunny skies and were subsequently asked how close their planned camping trip feels to them (the other scenarios were presented in the same manner). The question about perceived closeness was not referring to the event about which participants had received the probability estimate, but to a different event related to the first one. Even though those two events are connected, they are not the same. Looking at the scenario of rain and camping, for example, individuals might differ greatly regarding their tolerance of rain probability when it comes to deciding whether to go or not to go on the camping trip.

General Discussion

The aim of the present paper was to examine one of the key propositions of CLT, which states that higher psychological distance is related to higher construal level, while lower psychological distance is related to lower construal level. Specifically, the present study examined the probability dimension of psychological distance and its relationship to construal level. The proposition that probability is one dimension of psychological distance and that it influences construal level is widely recognized and subsequent studies built upon this proposition. However, this proposition is mainly based on studies from a single paper (Wakslak et al., 2006), which lacks replication studies. A recent replication attempt of those studies was not successful, even though it had a higher power than the original paper and therefore a higher probability of finding an effect (Calderon, 2020). Study 1 of the present paper also could not replicate the original finding of Wakslak et al. (2006). It is possible that the link between probability and psychological distance and subsequently construal level is not as strong as it is for the other dimensions (spatial, temporal and social) of psychological distance. Trope and Liberman (2010) suggest that the concept of probability might be less prominent and acquired at an older age than the concept of the other dimensions of psychological distance. Additionally, probability generally is a difficult concept to grasp and people tend to make mistakes regarding judgements about probabilities (Tversky & Kahneman, 1982). Those circumstances could lead to a weaker connection between probability, psychological distance and construal level. The unsuccessful replication in the present study emphasizes the importance of further studies investigating this relationship and examining if probability is related to construal level.

As mentioned in the discussion of study 1, the non-existence of a relationship between probability distance and construal level is just one of many explanations for the unsuccessful replication. Factors like a smaller sample size, conduction of an online study instead of a lab study, a more heterogeneous sample, and the unintentional additional manipulation of spatial psychological distance can also explain the findings of the present study. The present study

highlights the importance of context factors when it comes to the relationship between probability distance and construal level. The relationship might only be present in specific contexts and it might be susceptible to interferences (e.g., through other psychological distances). In a lab confounding variables can mostly be controlled for, but in the real world other variables are bound to be present and influence psychological distance, as well as construal level. For example, in the real world we rarely are confronted with just one dimension of psychological distance. Most likely, multiple distances influence our construal level interrelatedly, rather than as single, isolated distance dimensions. Likewise, it is possible that different population groups react differently upon psychological distances. It is also possible that psychological distance is perceived differently when it is induced in an online study instead of a lab or the field. Therefore, it is important to be careful when it comes to generalizing research findings about psychological distance and construal level, especially regarding recommendations outside a lab (e.g., recommendations for politicians deciding on new regulations). Future research should further explore how different contexts influence psychological distance and construal level to shed light on the limitations of this relationship.

In an attempt to explore one of the context factors possibly influencing psychological distance and construal level, study 2 of the present paper aimed to examine the influence of revisions of probability estimates. It was expected that upward revisions to a probability estimate decrease probability distance and lead to a lower construal level, than downward revisions. Contrary to expectations, this relationship was not observed. Revisions of probability estimates did not influence psychological distance. This finding is contradictory to the finding of Maglio and Polman (2016). Revisions of probability estimates subsequently also did not influence construal level. As in study 1, the non-existence of an effect is just one of many explanations for those findings. The observation that probability revisions did not successfully manipulate psychological distance could be due to the fact that the event for which the probability estimate was presented (e.g., sunshine on the days of a planned camping

trip) and the event for which participants should indicate experienced psychological distance (e.g., the planned camping trip) were related, but not the same. This confronts participants with a further abstraction step, which was not present in the study by Maglio and Polman (2016). It has to be noted, however, that this further abstraction step was also present in study 1 of the present paper, where the manipulation of psychological distance was successful. As the manipulation of psychological distance was successful in study 1, but not in study 2 and in both studies there was an additional abstraction step from one event's probability to another event's psychological distance, this additional step might not be a plausible explanation for the results of study 2. A more plausible explanation could lie in the provided probability estimates of study 2. In study 1 the difference of the probability estimates provided for group 1 and group 2 was very pronounced (95% vs. 5% probability). In study 2 the final probability estimates were at 95% for both groups. It was expected that the revisions prior to that final probability estimate cause enough psychological momentum in either an upward or a downward direction, for the two groups to significantly differ in psychological distance. Results of study 2 suggest that there was not enough psychological momentum for an observable difference in psychological distance between participants of the upward or the downward revision condition. A possible explanation for this observation are the high probabilities used in the reading tasks. As probabilities cannot exceed 100%, a probability estimate of 95% leaves little room for further upward revisions, thereby capping psychological momentum in this direction. Study 2 thereby provides insights in possible limits of psychological momentum. Future studies should examine psychological momentum in the context of probability estimates close to 100% or 0%.

Conclusion

Results of the present paper emphasize the need for replication studies, especially in the field of probability psychological distance and construal level. They further highlight the influence of context factors on the relationship of those two constructs. Regarding revisions of

probability estimates and psychological momentum, the present paper suggests that probability estimates that are close to 100% might cap the effect of psychological momentum and thereby curb the relationship between probability revisions and construal level. Future studies should explore under which circumstances a relationship between probability psychological distance, probability revisions and construal level is present.

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Appendix

A. Abstract (German)

Wakslak, Trope, Liberman and Alony (2006) haben in sieben Experimenten beobachtet, dass unwahrscheinliche (bzw. wahrscheinliche) Events mental abstrakter (bzw. konkreter) repräsentiert werden. Trotz mangelnder Replikationen dieses Zusammenhangs, ist er weitgehend akzeptiert und bildet die Basis für weitere Studien zu dieser Thematik. Studie 1 der vorliegenden Arbeit zielte darauf ab, Experiment 1 der Studie von Wakslak et al. (2006) zu replizieren. Studie 2 zielte darauf ab diese Ergebnisse zu erweitern, indem untersucht wurde, ob nicht nur statische Wahrscheinlichkeitsangaben, sondern auch abwärts (bzw. aufwärts) Revisionen von Wahrscheinlichkeitsangaben in Zusammenhang stehen mit abstrakteren (bzw. konkreteren) mentalen Repräsentationen. Die Ergebnisse unterstützen die Hypothesen von Studie 1 und 2 nicht. Die vorliegende Arbeit zeigt mögliche Limitationen des Zusammenhangs zwischen Wahrscheinlichkeitsangaben und mentalen Repräsentationen auf. Sie unterstreicht die Wichtigkeit weiterer Replikationsstudien um auszuloten, unter welchen Umständen dieser Zusammenhang vorliegt, bevor Ergebnisse generalisiert werden.

B. Preregistration

As Predicted:"Probability and Construal Level" (#51991)

Created: 11/12/2020 03:36 AM (PT)

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1) Have any data been collected for this study already?

No, no data have been collected for this study yet.

2) What's the main question being asked or hypothesis being tested in this study?

H1: When reported probabilities of events are low (vs. high), participants are broader in their categorization of objects.

H2: A downward (vs. upward) revision of the probability of an event leads people to categorize objects more broadly.

3) Describe the key dependent variable(s) specifying how they will be measured.

Construal Level, assessed via a categorization task (broader categories -> higher level of construal)

4) How many and which conditions will participants be assigned to?

One of two conditions:

Study 1: high or low probability

Study 2: downward or upward revision of probability

5) Specify exactly which analyses you will conduct to examine the main question/hypothesis.

A mixed design analysis of variance (ANOVA), with scenario as a within-subject factor and probability as a between-subjects factor will be conducted for both studies.

6) Describe exactly how outliers will be defined and handled, and your precise rule(s) for excluding observations.

Exclusion criteria:

Participants with insufficient German skills (only participants who indicate to be native or fluent in German will be included)

Participants who did not complete all 4 categorization tasks

Participants who did not answer at least 2 out of 4 comprehension checks correctly

Participants under the age of 18

7) How many observations will be collected or what will determine sample size?

No need to justify decision but be precise about exactly how the number will be determined.

Study 1: N=100

Study 2: N=100

8) Anything else you would like to pre-register? (e.g., secondary analyses, variables collected for exploratory purposes, unusual analyses planned?)

Additionally, we will control for mood and attentiveness (using the PANAS scale), as well as for motivation (by asking three questions: "How motivated were you to categorize the items?", "How important did the categorization task feel to you?" “How difficult was it to categorize the items?”)