Social influence: A comparison between the absolute and relative component of majority size in their effects on conformity

Joran Veldkamp (5993113)

Abstract

This study investigates the effects of two different constructions of majority size on the level of conformity, which is defined as making the same choice as the majority. An absolute and a relative majority size component were examined separately and simultaneously, and subsequently evaluated in terms of model fit. Solomon Asch's classical line judgements experiments (1951, 1955, 1956) are taken as starting point and multiple theories are employed to derive a prediction for both an absolute and a relative effect of majority size on conformity. An experimental design was used in which 192 participants answered 30 binary (A, B) questions. In contrast to the control condition, the participants in the social influence condition were notified at each question about the choices of prior actors. We find evidence for a positive effect of majority size on conformity, for both the absolute and the relative term. However, the relative majority size has proved to be of better model fit and therefore to be more important in determining the level of conformity than the absolute term. Implications of these findings are pointed out, limitations that merit acknowledgement are discussed and suggestion for future conformity research are given.

Keywords

social influence, conformity, majority size, relative versus absolute, sequential decision-making

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Course coordinator: Prof. dr. Ineke Maas

Thesis supervisor: Prof. dr. Arnout van de Rijt

Second evaluator: Prof. dr. Ineke Maas

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Universiteit Utrecht

1. Introduction

The decision-making process of individuals is constantly influenced by the real or perceived choices, attitudes and behaviors of the people and entities around them (Cialdini, 2001). We regularly have to make a decision between two alternatives, while knowing how many others before us chose either one. An overwhelming amount of research shows that this piece of social information often leads to adopting the choice or action that the majority of predecessors has already made, even when this choice was incorrect or not considered the best response for the matter (e.g., Ash, 1951, 1952a, 1952b, 1955, 1956; Bond, 2005; Crutchfield, 1955; Lynn, Simpson, Walker & Peterson, 2016; Muchnik, Aral & Taylor, 2013; Salganik, Dodds & Watts, 2006; Van de Rijt, Kang, Restivo & Patil, 2014; Young, 2009). This social influence pattern is called "conformity" and means adjusting individual opinions, attitudes, beliefs, and behaviors so that they match those of the majority and/or the group norms (Cialdini & Goldstein, 2004). For the sake of simplicity, both conformity and social influence will be defined here as making the same choice as the majority.

This study takes Solomon Asch's classical line judgement experiments as its starting point. Asch (1951[1], 1955, 1956) created an experimental design where the participants had to compare the length of a given line to three other lines and then publicly declare which of them was of identical length. Every trial consisted of one real "naive" participant and seven confederates, with the confederates all purposely giving the incorrect answer while the correct answer was unambiguously clear at all times. The naive participant had to give the last answer of the group, so if one would go along with the group's erroneous response, this could only be due to group pressure and social influence (Asch, 1951). He found that 75% of the participants conformed at least once to the unanimous and incorrect majority. One third of the participants went along with the group's faulty response on average, while the error rate in the control condition was less than 1% (Asch, 1951, 1955, 1956). These results seem startling, but note that one out of every four participants, or 25%, did not conform at all and followed their own intuition consistently.

[1] Note that the first conformity experiment was published twice, also in Swanson, Newcomb & Hartley (Eds.) (1952a). Although visible in the reference list, we will solely refer to this first conformity experiment as the one published in Guetzkow (Ed.) (1951), as this was the first time it came to the attention and it is the most cited one.

Critics of Asch's studies have argued that the conservative cultural values in the 1950's in the U.S. caused the high conformity level (Perrin & Spencer, 1980; Wren, 1999), that judging lines has limited generalization possibilities because it is a trivial and artificial task (Hill, 2001; Milgram in Evans, 1980, p.188), and that the sample was biased because it consisted solely of male students (see e.g., Bond & Smith, 1996). The findings of Asch have had, despite the aforementioned criticisms, a dominant influence on the literature about conformist behavior as at least 130 Ash-type studies have been conducted since then (Bond & Smith, 1996; Bond, 2005). But the level of conformity is highly dependent on a variety of factors: whether the majority is unanimous or not (Hogg & Vaughan, 2009), whether the unanimity is broken by a confederate who gives the actual correct or an even more incorrect answer (Allen & Levine, 1968), what task is used (e.g. perceptual, opinions) and in which context (Coultas & Van Leeuwen, 2015), how difficult the task is (Asch, 1951; Baron, Vandello & Brunsman, 1996), whether participants could respond anonymously (Crutchfield, 1955), and whether they had to state their answer privately or publicly (Asch, 1951; Crutchfield, 1955). As a result of the latter two, Bond's meta-analysis (2005) even makes a dual taxonomy between Crutchfield and Asch paradigm studies.

Yet, the most salient point of disagreement in the existing literature concerns the exact form of the relationship between the size of the majority and the degree of social influence. In later work, Asch (1956) varied the number of confederates and concluded that the amount of social influence was optimal when the majority consisted of three people, and that additional people would not enlarge the level of social influence. However, follow up studies report conflicting results in regards to this relationship. For example, Gerard, Wilhelmy and Connolly (1968) found a linear relationship between group size and conformity, which is in contrast to the concave relationship found by Asch. Social impact theory (SIT), Social Influence Model (SIM) and Other-Total Ratio (OTR) are all major theoretical predictors that also differ from Asch about the form of the relationship (Latané, 1981; Tanford & Penrod, 1984; Mullen, 1983). We can distinguish between an absolute and a relative majority size. An absolute majority size of one is relatively speaking different when the difference in popularity between two alternatives is 1 vs. 0, than it is when the difference in popularity is 4 vs. 3. Mullen (1983) is the only one that takes this relative component of majority size into account. He finds that OTR is a reasonable fit for the relation between group size and conformity, for twelve conformity studies (Mean $R^2 = .78$.).

This is noteworthy, considering the fact that the discussed results have demonstrated a relationship with conformity for both the absolute and the relative component of majority size. However, no study has been able to systematically compare the two relationships. The focus of this study will therefore be on this unutilized comparison between absolute and relative majority size. The model fit of the two separate models – a model with the absolute and a model with the relative term – will be compared to each other using the Bayesian information criterion (BIC) (Schwarz, 1978) and the closely related Akaike information criterion (AIC) (Akaike, 1973, 1974). This will give an indication whether the absolute or the relative size of the majority is more important in determining the level of conformity, thereby adding a new dimension of knowledge to the concept of majority size and social influence. This brings about the following research question: *To what extent does the level of conformity depend on the absolute or relative differences in popularity of a given choice?*

Apart from delving into the juxtaposition of the absolute and relative majority in their relationship to social influence, this study improves on existing research in multiple ways. First, in this thesis, I will use an experimental method that combines elements of the Asch paradigm (binary choice, right versus wrong) and the Crutchfield paradigm (private answering). Thirty different questions are asked in the experiment, so the participants are also presented with more diverse tasks than the single and unambiguous task of identifying lines of the same length, as done within the Asch conformity studies. The outcomes can therefore be generalized to more real-life conformity circumstances, giving this research high ecological validity (McLeod, 2018). Thirdly, only one quarter of the conformity studies in Bond's meta-analysis (2005) combined male and female participants. By doing so here, we are able to make split-analysis of gender to see whether there exists a gender effect in the data. Fourthly, the only relatively large known Dutch study on conformity was carried out three decades ago, so it seems fruitful to test it in a new context and compare the results (see Vlaander & Van Rooijen, 1985). Lastly, in some cases it will also be possible to look at the effect of a majority size of more than nine, which has hardly been examined in previous conformity research (Bond, 2005).

You may wonder what is wrong with conforming to the majority, since we live in a society of consensus. Asch (1955) illustrated this strikingly in his concluding remark:

> Consensus is an indispensable condition in a complex society. But consensus, to be productive, requires that each individual contribute independently out of experience and insight. When consensus is produced by conformity, the social process is polluted. (Asch, 1955, p.8).

But going along with the choice of the majority in itself does not have to be wrong. The majority often removes individual errors, referring to the "wisdom of the crowd" phenomenon (Hogarth, 1978; Surowiecki, 2004). However, Van de Rijt et al. (2014) showed that arbitrarily created initial advantages randomly assigned to receivers, led to a gain in achievements for these receivers in comparison to non-receivers in four different systems: funding, rating, status awarding and social supporting. As a result, this success-breeds-success dynamic can possibly lead to wrong inferences created by the (arbitrarily) early success of, for example, erroneous information. So, on average it can still be wise to follow the majority, although there is a risk of following the outcome that turns out to be wrong. Disentangling the absolute and relative component of majority size in their respective effects to conformity provides the society with more insight in these, possibly unjustified, success-breeds-success dynamics. In addition, if policymakers want to ensure that individuals exhibit certain behaviors, it is beneficial to know in what numbers they must show certain majority sizes to achieve this. Especially for pro-environmental behaviors such as the reuse of towels, it is already known that descriptive normative influence signs (e.g., “75% of the people in this hotel reuse their towels”) work better than just providing information (Goldstein, Cialdini & Griskevicius, 2008; Reese, Loew & Steffgen, 2014; Schultz, Khazian & Zaleski, 2008). It is nonetheless unclear how absolute versus relative descriptions function in steering certain behavior.

This paper is organized as follows. The next section highlights multiple theories that will be applied to make predictions about the effect of the majority size on the level of conformity. Then, a description of the data is given and the precise methodological choices will be explained, where after the results are displayed, described and discussed. Lastly, conclusions will be drawn and limitations of the study that merit acknowledgment are discussed.

2. Theory

The objective of this study is to make a comparison between the absolute and the relative majority size in relation to conformity, and not to model the precise relationship. This section is therefore structured in the following way. First, Asch's explanations for the concave relationship between majority size and conformity in his experiments are described. Social Impact theory (SIT) and Social Influence Model (SIM) are subsequently explained as theories applicable to the absolute component of majority size in relation to conformity. Then, the self-attention theory (using Other-Total Ratio) (OTR) and the theory of cumulative advantage (CA) will be explained as theories about the relative majority size. Although some theories described here go into detail about the precise form of the relationship, for the sake of simplicity and perspicuity it is chosen to make no detailed predictions about this exact form. It was agreed with the thesis advisor that Hagenaars (2019) would investigate the precise form of the relationship, and that I would refrain from doing so. Instead, the decision was made to focus purely on the broad effects of absolute majority size and the broad effects of relative majority size, and to compare the two.

2.1 Absolute majority size

Asch (1951, 1955, 1956) found that the effect of the majority size on conformity was optimum when the majority consisted of three people and that additional people did not enlarge the level of conformity. He therefore concluded that the relationship between (absolute) majority size and conformity takes a concave form. Asch tried to provide a theoretical explanation for his findings only after the experiments were conducted, what essentially means his theory is a post-hoc theory. He argued that a unanimous majority can provide a lone individual with appropriate information about reality; and specifically, about the answer that should be correct. After the majority reached a size of three people, a certain "representativeness" about reality was achieved, in which one could speak of a visible recognition of consensus. Adding more people to this majority group would simply validate this representativeness and therefore not increase the level of conformity anymore. Asch also varied the number of supporters/dissenters and found that they shatter the unanimity of the majority and thus resulted in lower levels of conformity. However, no prediction with regards to the relative component of majority size can be derived from Asch's post-hoc theory, as he gave no explicit theoretical future expectations for a relative effect like he did for the absolute effect of majority size.

Social Impact Theory (SIT) (Latané, 1981) differs from Asch's reasoning of the concave relationship between majority size and the level of conformity. SIT states that an undefined number of social sources are performing impact on an individual, and that the quantity of this impact is dependent on the strength (*S*), immediacy (*I*) and number of social sources (*N*) in process. Strength (*S*) refers to the importance of a source to the individual, which can be determined, for example, by one's occupation or age. Immediacy (*I*) refers to how close the distance is between the source and the individual, both literally and figuratively, while the number of social sources (*N*) speaks for itself. It is argued that an increase in *S, I* or *N* will lead to an increase in the level of impact experienced. Latané (1981) emphasizes that neither of the three elements is necessarily more meaningful than the other in the resulting amount of experienced impact, but the focus for this thesis will naturally be on the number of sources (*N*). Latané (1981) argued that an absolute difference of one social source will be relatively more important if it is a step from zero to one, than it would be in case of a step from ninety-nine to one hundred. The first social source will therefore have the largest impact on the individual, the second source the second largest, and so on - resulting in a "negatively accelerating curve of the relationship between group size and conformity" (Bond, 2005, p. 332). Latané (1981) came up with his own *psychological law* that explains this relationship: $I = sN^t$.

(*I*) is the amount of social impact, which is dependent on the number of social sources (N) with a scaling constant (*s*) and an exponent with a value lower than one (^{t}). The latter makes sure a quadratic relationship is visible, as every additional social source will according to the formula always have less social impact than the social source before. The essential thought is that the larger the majority size, the higher the social impact. Each subsequent individual (N) adds to the level of impact, but less than the (N - 1)th person. Applying SIT to our binary study leads to the following prediction. The likelihood for one in choosing answer A (or B) depends on the number of previously answers in favor of answer A (or B). In line of SIT, the first choice in favor of answer A (or B) will have the largest impact on the level of conformity, the second choice in favor of answer A (or B) the second largest impact, and so on and so forth. This applies when one looks merely from the viewpoint of answer A or answer B. We can also apply SIT simultaneously to answers A and B to make a prediction about the relative component of majority size. This will be discussed in section 2.2.

Another theory that has a divergent interpretation about the form of the relationship between majority size and conformity is the Social Influence Model (SIM) (Tanford & Penrod, 1984). Tanford and Penrod (1984) draw heavily from Latané's theoretical arguments and argue likewise that social influence is to a great extent dependent on the number of sources in a particular group. However, they specify the relation to be in a cubic form so that not every additional member adds to the level of conformity, but that a certain tipping point exists where the effect levels off. They draw their model from a computer simulation model regarding jury decisions, called DICE (Penrod & Hastie, 1979, 1980). This was carried out by simulating with variations in the size of the jury and the number of confederates who purposely decided that the suspect was found innocent (Tanford & Penrod, 1983). SIM, as revised version of DICE, experiments with the number of targets and the number of social sources on the level of social influence. The corresponding equation of SIM[2] is: $I = \exp(-4 \times \exp(-N^{1.075})$

"*I"* is the amount of social influence and "*N*" is the number of influence sources, so the latter refers in this study to the number of times answer A (or B) has previously been chosen. Filling in different numbers for N makes clear how the form of the relationship is according to SIM. When one influence source is present, the amount of social influence (*I)* is 0.23, with two influence sources it increases to 0.61 and with three influence sources it rises to 0.86. The notion behind this equation is that SIM is in that way consistent with the finding by Asch (1951) that the second and third person will have more effect than the first one. It also specifies that the majority size is only decisive for conformity up to a certain point, where after additive members will not further increase the level of conformity. This becomes clear when we specify the formula to have 10 influence sources, as the amount of social influence is now 0.9997. Additional members will not further increase the level of conformity anymore, as SIM is specified not to exceed 1.0. This contradicts the earlier mentioned SIT, where every additional group member leads to an increased level of conformity. SIM consequently leads to an S-shaped function of the relationship between majority size and conformity (Bond, 2005).

[2] Altough Tanford & Penrod (1984) give 1.75 as the value for the second constant, it is highly likely that this is an unfortunate typo as Bond (2005), Coultas (2004) and MacCoun (2012) all showed that lower values resulted in better replication of Tanford & Penrod's results. We apply a simple majority rule and follow Coultas and MacCoun with the value 1.075, as Bond also differed from this and reported 1.175 as the most likely value for the second constant.

Asch's findings and his post-hoc arguments about representativeness of reality, Social Impact Theory (SIT) and Social Influence Model (SIT) thereby all predict the level of conformity to increase in the absolute size of the majority. This leads to the following hypotheses:

H1: Conformity increases in the absolute size of the majority

2.2 Relative majority size

The dimension that we have not yet taken into account is the effect of the relative majority size in relation to conformity. Relative majority size differs from absolute majority size in the sense that it is dependent on the number of choices that have already been made. Mullen (1983) proposed a straightforward numeric algorithm called the Other-Total Ratio (OTR) to account for this relative difference. OTR can explain multiple social influence phenomenon, and is in all cases about the group practicing influence on the individual. OTR is based on the self-attention theory (Carver, 1979; Carver & Scheier, 1981) - which basically states that the more attention is focused on the self, the more people will conform to the kind of behaviors they perceive as behavioral standards. It is argued that the perceived attention on the self is highly dependent on the relative number of people in your "own" group that support your point of view (Mullen, 1983). The structure of the group is therefore decisive in the degree of conformity. The OTR is always calculated by dividing the majority size by the total number of people present (so the majority plus minority). This is depicted in the equation: *Other-Total Ratio = 0 / 0 + S*.

"*O*" corresponds to the majority size and "*S*" corresponds to the minority size. So, the more the "own" group relatively decreases, or the more the "other" group relatively increases, the more attention will be focused on the self and therefore more behavior will be matched towards the behavioral standards. OTR thus clearly includes two groups and the relative difference in size for those groups in its explanation, and is therefore very suited for our binary study. We can alter the formulation in the following way: *Choosing answer B = B / B + A.*

"*B*" now corresponds to the number of times answer B was previously chosen and "*A*" now corresponds to the number of times answer A was previously chosen. Of course, we can simply swap the A's and B's in the equation to get the same formula for *Choosing answer A* instead.

As mentioned before, Social Impact Theory (SIT) is also applicable to our binary design in making predictions with regards to the relative component of majority size. It was argued that the likelihood for one in choosing answer A (or B) depends on the number of previously answers in favor of answer A (or B). According to SIT, the first choice for a particular answer will have the largest impact on choosing that same answer, the second choice the second largest impact, and so on. But instead of looking solely from the viewpoint of A or B, we can also apply SIT to both of them at the same time to derive a prediction for a relative effect instead. This leads to the following equation: $I = \frac{s\mathrm{Bt}}{s\mathrm{At}}$

Now, the amount of social impact (*I*) is based on the amount of social impact for answer B divided by the amount of social impact for answer A. The individual social impact for each of the answers are again based the number of social sources (prior choices for that answer) (N) with a scaling constant (*s*) and an exponent with a value lower than one (^{t}). The latter makes sure the quadratic relationship is still visible. This new formula clearly specifics a relative effect of majority size on the amount of social impact, and thus on the level of conformity.

The theory of cumulative advantage (CA) is another theory that will be applied to derive a prediction about the relative component of majority size. The core aspect CA theory is well summarized by the statement “the rich get richer at a rate that makes the poor become relatively poorer” of Robert Merton (1968). The CA principle basically claims that an initial advantage of a person (or practice) over another person (or practice) will over time accumulate in even more success and advantage for that person (or practice). CA finds its origin in studies of the Matthew effect: Scientists who delivered acknowledged work are more likely to receive credits and achieve success again, compared to scientists who delivered less acknowledged work. (Merton, 1968, 1973a, 1973b, 1988). In addition to the aforementioned terms, CA has also been labeled as “vicious cycles” or “success breeds success” (DiPrete & Eirich, 2006; Van de Rijt et al., 2014). Allison, Long and Krauze (1982) apply the Contagious Poisson process (Coleman, 1964) to model the cumulative advantage regarding publications and citations of scientists. The difference with the regular Poisson model lays in the fact that earlier success is included in the contagious model (DiPrete & Enrich, 2006). The formulation of the model by Allison et al. (1982) is displayed in the following equation: $P(t) = \alpha + \beta X(t)$.

P(t) is the likelihood of publishing at time t, which basically means the number of published articles in one timeframe. Everyone has the same likelihood of publishing at the outset, represented by α. Then, every additional publication boosts the likelihood of publishing by a fixed quantity denoted by β - which can be understood as the pace of cumulative advantage. Lastly, X (t) is the number of published papers at time t. I altered the formulation and interpretation of the notation so that it is applicable to this particular study of binary decision-making between answer A and B, as shown in the following equation: $B(t) = \alpha + \beta X(t)$

Let B(t) now be the probability of the choice to be answer B at time t. Every additional choice for answer B now increases the probability of choosing answer B by the fixed amount β, and let X(t) now be the relative majority size in favor of answer B in comparison to answer A at time t. The constant probability at the beginning is still denoted by α. This clearly demonstrates that each choice for answer B relative to the choices for answer A increases the likelihood of subsequent choices for answer B, while it is still partly ruled by random chance as the total number of choices for B is a changing variable. Both the self-attention theory with the corresponding Other-Total Ratio (OTR) (Mullen, 1983) and the theory of cumulative advantage (CA) with the corresponding Contagious Poisson model derive at the notion that the level of conformity increases when the relative size of the majority increases. This brings about hypothesis 2:

H2: Conformity increases in the relative size of the majority.

Table 1 shows an overview of the discussed theories and hypotheses. An X in each cell represents a theory meeting a hypothesis.

Table 1. Overview of theories applying to hypothesis

	Hypothesis	
Theory	H1: Absolute	H2: Relative
Asch's post-hoc theory about representativeness	X	
Social Impact Theory (SIT)	X	X
Social Influence Model (SIM)	X	
Other-Total Ratio (OTR)		X
Cumulative advantage theory (CA)		X

3. Data and Methods

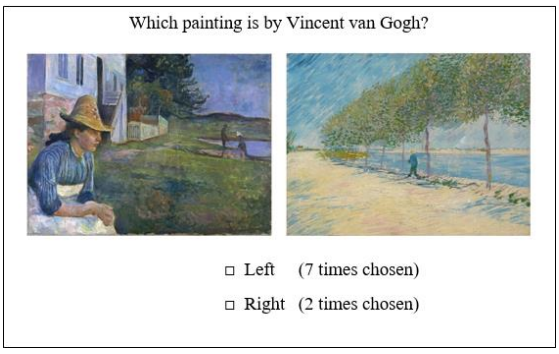
This section will be set out as followed. First, a description of the data is provided. Then, the operationalization of all variables will be discussed, followed by an explanation of the analysis method. The section will be concluded with a table of descriptive statistics of all variables used in the subsequent analysis.

3.1 Description of the data and subjects

This study makes use of the experimental dataset the Unwise Crowds, collected between 2 and 14 March 2017 (Frey & van de Rijt, 2019). The researchers conducted the experiment at the laboratory of Martinus J. Langeveld building at Utrecht University. Each session consisted of ten to fourteen participants randomly assigned to the experimental *social influence* condition and the same number of participants to the *independent* control condition, with eight sessions in total (N=192). Participants had to answer a total of thirty binary questions, while sitting isolated behind a computer desk with no means available to infer the correct answer. All subjects were provided with the questions in the same order, but with different starting points to prevent delay in the procedure. The questions were equally divided between the subjects visual, art, equations, history, and geometry, thus six questions for each of these subjects. For each question, one could either choose A or B and always only one of those was unambiguously correct. In contrast to the control condition, the participants in the social influence condition were notified at each question how popular both options were at that time by showing how many others had chosen A or B prior to them. An example of this is shown in figure 1 below, see appendix 1 for the entire questionnaire. A reward incentive system was carried out to motivate participants to answer correctly, with ten cents pay-off for each question when the majority of the group gave the correct answer and five supplementary cents for each individual legitimate answer. This pay-off design ensures that the social influence effect is conservative, since participants are now aware that their individual answers may have the power to steer the majority in the right direction (Frey & van de Rijt, 2019). Important to note is that the participants were only given twenty seconds to answer, so no answer was saved once the time ran out. It may for example be that participants did not know the answer or that they accidentally let the time pass. Additional information like this is not of great interest in this study, but available upon request.

The 192 subjects consisted to a large extent of university students enrolled in education without having a degree. The age distribution was concentrated between the 18 and 30 years old, as 92.2% of the subjects fell within this range. The possibilities of generalization to the older cohorts of society may be limited by this age range, but in combination with the high variety of studies and nationalities it seems to be an accurate representation of Utrecht University students in general. There are also much more women than men (67% vs. 33%) in the data, but this partly represents the women's surplus of the city of Utrecht in the age range 20-25 years old (Statistics Netherlands [CBS], 2018). To conclude, the sample thus consisted mainly of young female undergraduate students of Utrecht University, and specifically social sciences students. Because we are aware of the possible biased sample, there will be tested for group differences in the effect of majority size on the level of conformity. The participants answered thirty questions, which resulted in a total number of 5760 binary choices as final *N*.

Figure 1. Example of a question with the popularity count for each choice, only visible for the social influence condition.



3.2 Operationalization

Majority size. The main independent variable in this research is majority size, for which both an absolute and a relative component were created. Absolute majority size was constructed by subtracting the total number of times answer A was chosen from the total number of times answer B was chosen. The more the score deviates from zero in a positive direction, the more popular answer B was at that time. Vice versa, the more the score deviates from zero in a negative direction, the more popular answer A was at that time. This results in a scale ranging from -12 to 12, with a score of zero indicating that the two choices were equally popular at that time.

The relative component of majority size is, like explained in the theory section, constructed by dividing the absolute majority size by the total number of choices made by previous actors. The 521 cases in which the total number of previous choices made was zero, were set to missing in order to avoid dividing by zero. This relative scale provides more variation in the majority size variable, as a popularity count of 2 vs. 1 now has more impact towards the level of conformity than a popularity count of 7 vs. 6. This is in contrast with the absolute majority size, where these instances would both have a score of 1. The resulting relative majority size variable is a proportion scale (-1 = Unanimous majority A, 0 = no majority, 1 = Unanimous majority B).

Conformity. The objective of this study is to make inferences about the degree of social influence and particularly about the level of conformity. It has however been decided to refrain from constructing a specific variable that reflects this level of conformity. Instead, the answer that the participants reported (0 = A, 1 = B) is used as dependent variable as the level of conformity is in that way rooted in the effect of the majority size on the answer provided. There is nevertheless also a dummy variable constructed that shows whether the answer provided by the respondent matches the answer attained by the majority of preceding actors (or not). This dummy is constructed in an aim to replicate Asch's chart about the diminishing effect of majority size after a majority size of three (see appendix 2). A score of 1 was assigned when the respondent had chosen either A or B and the majority did the same, and a score of 0 was assigned when the majority chose the alternative answer instead. The 928 cases where the popularity of a choice was equal were set to missing. Then, for each majority size the percentages of the same answers as the majority were calculated and assigned as value in the variable *percentage of conformity*.

Difficulty of the question. It is plausible to expect that when individuals have more uncertainty, they will more often rely on others and thus follow the majority more often (Baron, Vandello & Brunsman, 1996). To take this into account, dummy variables are included in the models for each of the thirty questions (actually 29/30, as 1 will be the reference category). These dummies are included to control for the variations in difficulty for each question. In this way, the effects of the questions can be understood as being fixed, and the social influence effect of the majority size on the answer provided can be interpreted more effectively and with less noise.

Controls. The following other control variables are included: whether a participant is of Dutch or Non-Dutch origin, whether a participant is a student of any of the social sciences of Utrecht University[3], and the age and gender (0 = female, 1 = male) of the participants.

3.3 Analysis method

As mentioned before, our main dependent variable in the analysis is the answer the participants provided at each question (0 = A, 1 = B). A binomial logistic regression was employed as analysis method, as this is the way-to-go when predicting a variable with a binary outcome and the answer provided by the respondents is undeniably a binary outcome. Logistic regression predicts the likelihood of an observation to belong to one of the two groups by calculating odds ratios. Logistic regression assumptions were investigated and determined to have been satisfied regarding measurement level of the dependent and the independent variables, and the exclusiveness and exhaustiveness of the categories of the dependent variable. The assumption of independence of observations is on the other hand violated, as every choice of a participant is treated as an independent data point while in fact they are not. All 192 subjects made thirty choices, so those thirty observations are dependent on the subjects. Violation of this assumption is not considered problematic for this thesis[4]. The assumption of linear relationships between any independent variable of continuous measurement level and the log transformation of the dependent variable was checked using the Box-Tidwell test (1962). All interactions between each continuous predictor and its natural log are insignificant, meaning we do not violate the assumption of linearity for logistic regression (Wuensch, n.d.)

[3] All Bachelor's and Master's programs of the Faculty of Social and Behavioural Sciences of Utrecht University are listed in Appendix A3.

[4] This issue has been discussed with the thesis advisor and we agreed that fixing this violation trough multi-level models is beyond the scope of this thesis.

Table 2 below provides the descriptive overview of all variables that will be included in the models in the next section.

Table 2. Descriptive statistics of all variables

	Social influence condition			Control condition			
Variables	*N*	*M*	*S.D.*	*N*	*M*	*S.D.*	*Range*
Answer	2681	0.53		2791	0.52		0 - 1
Absolute majority size	2820	0.28	4.68	2940	0.18	3.50	-12 - 12
Relative majority size	2553	0.05	0.81	2686	0.03	0.65	-1 - 1
Age	2820	23.86	6.03	2940	23.51	6.84	18 - 66
Male	2820	0.33		2940	0.34		0 - 1
Dutch-origin	2820	0.54		2940	0.60		0 - 1
Social Science student	2820	0.29		2940	0.31		0 - 1
Q1 – Q30[a]	2820			2940			0 - 1
Valid N	2441			2551			

* Note: For all dummy variables, the proportions instead of the means are displayed in the means (*M*) column

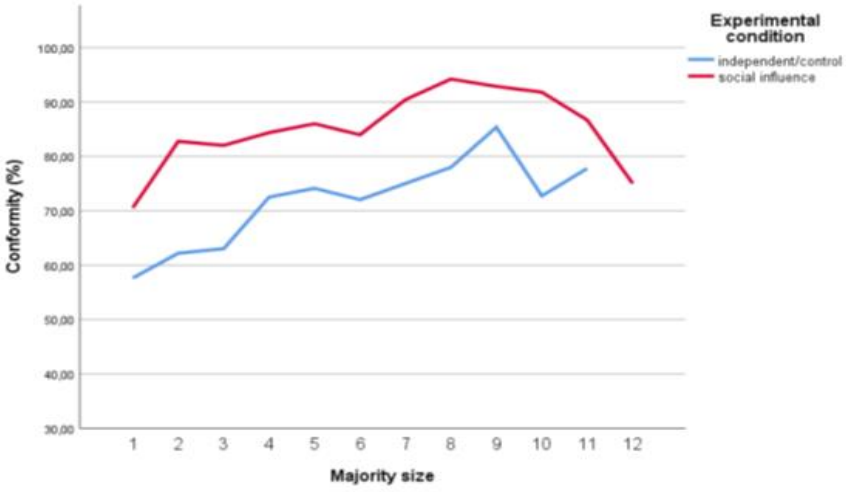
[a] This represents the 30 dummy variables for each of the questions. It is not intuitive to give descriptive statistics, as they are solely included in the analysis for fixed effects purposes.

4. Results

The results in this section will be discussed in the following order. First, Asch's graph is constructed and its ramifications are discussed. Then, a table is presented with two separate models: a model with the absolute majority size variable and a model with the relative majority size variable, both in relation to the level of conformity. Comparison between the models will be done in terms of the model fit indices Bayesian information criterion (BIC) and the Akaike information criterion (AIC). Next, the same two models are being estimated but now with inclusion of several control variables. At last the absolute and relative majority size terms are taken together in one model to test if one maybe clearly dominates the other. Recall that the dependent variable used all models is the answer provided by the participants (0 = A, 1 = B). Thus, the level of conformity is not represented in a distinctive variable but is rooted in the effect the majority size exerts on the choices made.

A replication of Asch's graph (1955) of the diminishing effect of majority size on conformity is visible in figure 2. It shows the percentages of choices which were identical to the choices made by the majority, displayed per absolute majority size and differentiated by color for the two conditions.

Figure 2. Percentage of choices which were the same as the majority.



It becomes clear that for every majority size, there are substantially higher rates of conformity for the social influence condition as compared to the independent control condition. Further initial support for a social influence effect is found when we check whether the total amount of same answers as the majority differs between the two conditions. An independent samples T-test was conducted and a significant difference was found in the scores of the social influence condition (M = 0.83, SD = 0.38) compared to the independent control condition (M = 0.65, SD = 0.48); t (4343.449) = - 14.015, p < .001/2. At first glance, this figure 2 therefore appears to provide clear evidence of social influence. However, upon further investigation, it becomes apparent that the social influence effect is fundamentally confounded with the fact that for easy questions people seem to follow the majority but simply all give the right answer. Figure 2 clearly shows this confounding effect, because in the control condition you do not know what the majority is and still you can find an effect; which is by all means impossible. This bivariate result provides a rationale for this study to do a multivariate analysis instead, and also to carefully test whether this social influence effect is no longer visible in the control condition when we do so. Results of the control condition can be consulted in appendix A4.

To assure that all variation caused by the varying difficulty rates for each question is omitted, we include dummies for all 30 question in our binary regression models (naturally 1 of those will be excluded from the model, so in fact 29 dummies). The confounding effect of the difficulty rates of the questions on the choice made is in that way isolated, and the effect of majority size on the answer provided can therefore be interpreted solely as a social influence effect.

Table 3 shows the logistic regression results with regards to both the absolute and the relative component of majority size in relation to the level of conformity, displayed in separate models. Model 1 includes the absolute majority size variable, while model 2 includes the relative majority size variable. Both models also include the dummies for each of the individual questions. From now on, there will be referred to models 1 and 2 as the absolute majority size model and the relative majority size model respectively. Table 3 – Model 1 shows that the estimated absolute majority size model gives a good overall model fit and is a significant improvement in fit over the null model, with X^2 (30) = 1275.9, p < .001. Furthermore, 80.6% of the overall values are being correctly classified to fall into the respective binary categories.

Table 3. Binary logistic regression results of both the absolute and the relative majority size on the level of conformity, with the answer provided as dependent variable.

	Model 1 - Absolute				Model 2 - Relative			
Variable	B	S.E.	Odds Ratio	95% CI OR	B	S.E.	Odds Ratio	95% CI OR
Constant	-.994	.288	-	-	-1.021	.318	-	-
Majority size	.281***	.015	1.33	1.29, 1.37	1.639***	.081	5.15	4.40, 6.03
Q1 – Q30[a]	29				29			
Likelihood ratio X^2	1272.3***				1281.1***			
AIC	1163.2				1129.9*			
BIC	1345.9				1309.7*			
CA	80.5%				82.3%			

Note: *p < 0·05; **p < 0·01; ***p < 0·001 (two-tailed tests). Source = Unwise Crowds Data (Frey & van de Rijt, 2019).

[a] Dummy variables for each of the questions were included. The number in the table corresponds to the number of dummy's included. Reference category is Q30 for both models.

Considering the individual coefficients, we can see that the effect of the absolute majority size on the answer provided by the respondent is positive and statistically significant, with $b = .281$, *Wald* $X^2 = 330.3$, $p < .001$. The respective Odds Ratio (*OR*) is 1.33 (95% CI: 1.29, 1.37). The confidence intervals are > 1.0, indicating that every unit increase on our predictor variable (absolute majority size) significantly increases (1.33x) the probability of membership of the target group as compared to membership of the non-target group. Our target group is answer B, because we coded answer B as "1" and answer A as "0". However, it also works the other way around towards a majority of answer A, because of our construction of the absolute majority variable (-12 = maximum majority answer A, 0 = no majority visible, 12 = maximum majority answer B). So, every increment in the majority size of answer A also resembles a 1.33 times increase in the probability of falling into the respective answer A group. This result provides initial support for hypothesis 1: that conformity increases in the absolute size of the majority.

Switching to the relative majority size (Table 3 - Model 2), we can see that the estimated model gives good overall model fit and is, like the absolute majority size model, a significant improvement in fit over the null model, with $X^2 (30) = 1281.1$, $p < .001$. The same pattern is visible when we take into account the individual effect of the relative majority size on the answer provided by the participants, as it is again positive and statistically significant, with $b = 1.639$, *Wald* $X^2 = 411.0$, $p < .001$. The OR of the relative majority size component is 5.15, with a 95%

CI ranging from 4.40 to 6.03. The confidence intervals are > 1.0, which, like for the absolute majority size term, indicates a significant increased probability of belonging to the target group compared to belonging to the non-target group (5.15x); for every unit increase in the majority size variable. However, one unit increase in this relative majority variable is already the step from the minimum value to the maximum value for both answer options (-1 = Unanimous majority A, 0 = no majority visible, 1 = Unanimous majority B). So, this OR reflects the difference in probability between a majority size of zero and a unanimous majority. These results provide an initial support for hypothesis 2 that conformity increases in the absolute size of the majority.

Although only slightly, the classification accuracy for the relative majority size model increased with 1.8% over the absolute majority size model, correctly classifying 82.3% of the overall values. This provides an early indication of a difference between the absolute and relative component of majority size in their respective relation to the level of conformity, because everything else in the models is exactly the same. The two separate non-nested models are compared to each other in terms of model fit to test and provide evidence for this initial claim. The Bayesian information criterion (BIC) (Schwarz, 1978) and the closely related Akaike information criterion (AIC) (Akaike, 1973, 1974) are employed in doing so. Both model fit statistics are penalized-likelihood criteria that present a penalty term for the number of parameters (Dziak, Coffman, Lanza, Li & Jermiin, 2019). When to models are non-nested, the differences (⌂) in AIC and BIC can be compared to each other in order to asses which of the models fits best to the data. The model with the lowest AIC and BIC values is referred to as the best model, while the other model is called the candidate model. As visible in table 3, the best model in our case is the relative majority size model (denoted by an asterisk in the table), while the absolute majority size model is the candidate model. Table X below shows the general rules of thumb for both model fit indices (Burnham & Anderson, 2004; Fabozzi, Focardi, Rachev & Arshanapalli, 2014).

Table 4. General rules of thumb regarding difference (⌂) in AIC and BIC.

Akaike Information Criterion (AIC)		Bayesian information criterion (BIC)	
Difference (⌂)	*Substantial meaning*	*Difference (⌂)*	*Substantial meaning*
< 2	Support for candidate model	< 2	Barely worth mentioning
4 - 7	Considerable less support candidate model	2 – 6	Positive evidence against candidate model
> 10	No support candidate model	6 – 10	Strong evidence against candidate model
		> 10	Very strong evidence against candidate model

The AIC⌂ is calculated by subtracting the AIC of the best model from the AIC of the candidate model: 1163.2 – 1129.9 = 33.3. The same formula is applicable to the BIC⌂: 1345.9 – 1309.7 = 36.2. These differences are undeniably higher than 10. So, after investigation of table 4, it becomes clear that for both information criterion there is very strong evidence against the candidate model and thus in favor of the best model. As mentioned before, the best model is the model with the lowest values, so the relative majority size model was the best model in this study and thus proved to be of better model fit than the candidate model. These results provide strong evidence that the relative majority size is more important in determining the level of conformity in comparison to the absolute majority size component.

Two additional models are being estimated, again separately for the absolute and the relative component. These models additionally include interaction terms for age, gender, being Dutch and being a Social Science student. This is done in order to test whether the control variables change any effect of the majority size on the level of conformity. The main effects of the aforementioned control variables are also included in the models, but note that they are not of interest and therefore excluded from the tables. It would of course make no sense to test whether being a male or being older would have an effect towards choosing answer A or B. Interacting them with the majority size terms does however serve its purpose, as it now tests whether the effect of the majority size on the answer provided differs for each of the listed control variables. Table 5 is therefore equivalent to table 3, but now shows the logistic regression results when the control variables are included.

Table 5. Binary logistic regression results of both components of majority size in relation to the level of conformity, with the answer provided as dependent variable.

	Model 1 - Absolute				Model 2 - Relative			
Variable	B	S.E.	Odds Ratio	95% CI OR	B	S.E.	Odds Ratio	95% CI OR
Constant	-.085	.345	-	-	-.097	.390	-	-
Majority size	.232**	.071	1.26	1.10, 1.45	1.281***	.365	3.60	1.76, 7.37
Q1 – Q30[a]	29				29			
Age*majority size	.003	.003	1.00	0.99, 1.01	.022	.014	1.02	0.99, 1.05
Male*majority size	-.084*	.033	0.92	0.86, 0.98	-.593***	.167	0.55	0.40, 0.77
Dutch*majority size	-.004	.033	1.00	0.93, 1.06	-.076	.168	0.93	0.68, 1.29
SS[b]*majority size	.062	.036	1.06	0.99, 1.14	.330	.183	1.39	0.97, 1,99
Likelihood ratio X^2	1287.0***				1303.4***			
AIC	2465.5				2095.9*			
BIC	2695.4				2322.2*			
CA	80.6%				82.0%			

Note: *p < 0·05; **p < 0·01; ***p < 0·001 (two-tailed tests). Source = Unwise Crowds Data (Frey & van de Rijt, 2019).

[a] Dummy variables for each of the questions were included. The number in the table corresponds to the number of dummies included. Reference category is Q30 for both models.

[b] SS = Social Science student

The stepwise additions of the interaction terms to the models do result in a significant model fit improvement over the model without the interaction terms, with X^2 (4) = 11.140, p < .025 for the absolute majority size model and X^2 (4) = 17.994, p = .001 for the relative majority size model. This significant improvement for both models seems to be mainly due to the significant interaction effect of gender with majority size (p = .011 for absolute and p < .001 for relative). The corresponding negative ORs of 0.92 and .055 for absolute and relative majority size respectively, basically means that the effect the majority size has on the probability to fall into the target group is lower for males than for females, as males were coded as value 1. The negative OR can for ease of interpretation also be converted in the opposite direction. The odds of a falling into the non-target group (in the answer A or "0" group) increases then with (1 / 0.92) 1.09 for males as compared to females, for the absolute majority size model. For the relative majority size model the opposite odds are (1 / 0.55) 1.82 for males as compared to females. Males seem therefore less susceptible to the influence of the majority size on their choices than women are. None of the other control interaction terms are statistically significant, so there is no effect of age, being Dutch of studying one of Social Sciences in our data.

The main effect of the absolute majority size decreases slightly, but is still positive and statistically significant, with $b = .232$, $p = .001$, $OR = 1.26$ (95% CI: 1.10, 1.45). The same pattern is visible for the relative majority size term, with $b = 1.281$, $p < .001$, $OR = 3.60$ (95% CI: 1.76, 7.37). The AIC⌂ and BIC⌂ differences between the absolute majority size and the relative majority size model are even larger when the interaction terms are included. The AIC⌂ is 2465.5 – 2095.9 = 369.6, while the BIC⌂ is 2695.4 – 2322.2 = 373.2. Taking into account the substantial meanings of the ⌂differences in table 4, very strong evidence is again found against the (absolute majority size) candidate model and thus in favor of the relative majority size model.

Finally, a model has also been estimated (not displayed here) that includes both the absolute and the relative term together with the dummies for each individual question. This carried out in order to test if one of them might completely dominate the other one or if they would both stay statistically significant and in the same direction in their effects on the level of conformity. The latter was indeed the case. The absolute term was still significant and positive, with $b = .111$, $p < .001$, $OR = 1.12$ (95% CI: 1.06, 1.17). The same applies to the effect of the relative majority size component, with $b = 1.108$, $p < .001$, $OR = 3.03$ (95% CI: 2.31, 3.97). Collinearity issues were checked and determined to not be of great concern (Absolute majority size, Tolerance = .277, VIF = 3.604; Relative majority size, Tolerance = .272, VIF = 3.673).

To conclude, adding both of the majority size terms together in one model or adding the interaction terms to the separate models does not change any main effects of majority size, and it does also not eliminate the significant difference in model fit between the absolute and the relative majority size model. It does in fact even enlarge the model fit difference between the two components. These findings therefore confirm both hypothesis: (H1) Conformity increases in the absolute size of the majority and (H2) conformity increases in the relative size of the majority. The explorative part of the analysis furthermore showed a strong indication that the relative majority size is more important in determining the level of conformity than the absolute majority size.

5. Conclusion and Discussion

This study has delved into the effects of two different constructions of majority size on the level of conformity. An absolute and a relative majority size component were investigated separately and simultaneously, and subsequently evaluated in terms of model fit. Several theories have been employed to derive predictions regarding an absolute effect of the majority size on conformity (Asch, 1951, 1955, 1956; Latané, 1981, Tanford & Penrod, 1984) and two additional theories have been used to develop hypothesis regarding a relative effect of the majority size on conformity instead (Allison et al., 1982; Mullen, 1983). Essentially, they all express the same idea: we are influenced by the actions or perceived actions of the people around us. Results of this thesis are in fact in line with all of them, as we have found a significant effect for the absolute as well as for the relative majority size term in relation to the level of conformity. Although the theories discussed do differ in their interpretation of the precise form that the relationship between majority size and conformity takes, this has not been investigated here. As mentioned before, I refer to Hagenaars (2019) for the exact form of the relationship. The focus of this thesis was mainly on the explorative part that followed the two separate relationships, in which the individual models with the different majority size components were compared to each other in terms of model fit.

Compelling differences (⌂) in model fit statistics BIC and AIC were found between the two models in favor of the relative majority size model, and this result persisted after inclusion of the control variables age, gender, being Dutch and being a Social Science student. These results have provided strong evidence that the relative term is more important in determining the level of conformity than the absolute term, given our experimental data. The main findings of this study are well captured by the following statement: Absolute majority size is decisive for the level of conformity, but relative majority size even more. It is difficult to delve deeper into this comparison without rapidly becoming too philosophical or too abstract, as it is commonly claimed that everything is in fact relative to something else (e.g. by Alfred Stieglitz). However, we can learn a few things from this particular finding. When people are perfectly and truthfully informed about the choices of prior actors, then the relative difference in popularity of each alternative matters more in their decision-making process than the absolute. This can either work consciously or unconsciously, but is important nevertheless. Recall what was mentioned in the

introduction about the implications for policymakers regarding steering particular behavior, if either the absolute or the relative component would have been found to matter more. Let us take the example of steering pro-environmental behavior. Imagine that policymakers want to ensure that individuals exhibit certain behaviors, by exposing them to the fact that a certain majority size already performs this particular behavior. If they show these majority sizes in absolute numbers, then, in line with our results, we can assume that the individual makes the step to relative in their thought process and use this as an important determinant for their final choice. However, if only absolute majority sizes are displayed (e.g., "20 people reuse their towel"), then chances are high that the assessment of the relativity may be erroneous. In that case, the decision will me made based on the false popularity count of both alternatives (exhibiting certain behavior versus not exhibiting that certain behavior). Therefore, the recommendations of my findings are focused on how the majority sizes are showed to individuals. If the goal is steering behavior, the majority sizes must be shown in absolute numbers for both alternative actions, so that individuals can make the translation to relative. Even better is showing the majority sizes in relative terms, in order to avoid the risk of a wrong translation to relative sizes in the decision-making process. Research has already extensively investigated the effect of normative influence signs for multiple pro-environmental behaviors, like energy use (Nolan, Schultz, Cialdini, Goldstein & Griskevicius, 2008), curbside recycling (Schultz, 1999) and the reuse of towels (Reese, Loew & Steffgen). Policymakers in these fields may draw considerably from the results of this thesis in combination with the existing literature.

This study have limitations that merit acknowledgement. The subjects almost solely consisted of Utrecht University students, with most of them being a social science student. The sample was also quite biased towards females and young people, as 92.2% was concentrated between the age range of 18 and 30. Although these data was very suitable for the experiment and although we tested for differences in effects for these overrepresented groups, this does limit our generalization possibilities. A sample of older cohorts, more men and more diverse geographical locations would be needed to get a better representative picture of the overall effect of majority size on the level of conformity. Secondly, as acknowledged in the data and methods section, the assumption of independence of observations was violated in this experiment. Every binary choice of the participants was treated as a single data point, which makes the observations

dependent on participant level. Multilevel models are needed to deal with the violation of this assumption, but have been determined to be beyond the scope of this study. Further, in the introduction we mentioned the possibility to test the effects of (absolute) majority sizes of more than nine because little was known about these majority sizes in previous research (Bond, 2005). However, only 62, 46 and 12 overall binary choices were made for the absolute majority sizes 10, 11 and 12 respectively. We have thus not been able to make valid inferences for these high majority sizes, as it must be conclude that we had too little power in our data for these majority sizes of more than 9.

For future research, it can be interesting to see how the level of conformity behaves when higher majority sizes are visible (e.g., majority sizes of 9-15). Further, the theories discussed in this study differed from each other about the reasons why people conform. It has been argued that people conform because the majority offers representativeness about reality (Asch, 1951, 1955, 1956), that it is dependent on the strength, immediacy and the number of social sources in process (Latané, 1981), that it is dependent on the amount of attention that is focused on the self (Carver, 1979; Carver & Scheier, 1981; Mullen, 1983) and that success-breeds-success through cumulative advantage (Allison et al., 1982; Van de Rijt et al., 2014). For future conformity research, it is interesting to investigate this dimension trough qualitative interviews right after the experiment, and ask the participants about their reasons to conform. In that way we might be able to link it to the reasons above, or to make the link to the theoretical distinction of Deutsch and Gerard (1955). They proposed two reasons why people conform: *Informational conformity* happens when individuals conform because they obtain relevant information about reality by seeing what other people did in the same situation, while *normative conformity* is merely a reflection of our need of acceptance and approval - we do not want to be punished by the group for not conforming. Disentangling these reasons and combining them with the results of the majority size effects can give us new insights in the concepts of conformity and majority sizes. Lastly, a likewise experiment should be conducted with three groups instead of two: the control condition, a social influence condition with absolute majority sizes shown and a social influence condition with relative majority sizes shown. This makes it possible to make a more accurate, systematic comparison between the absolute and the relative component of majority size.

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Appendix

A1. The entire questionnaire.

List of questions: The answering categories are in parentheses, with the correct answer underlined. Shapes and images were shown to subjects in larger size.

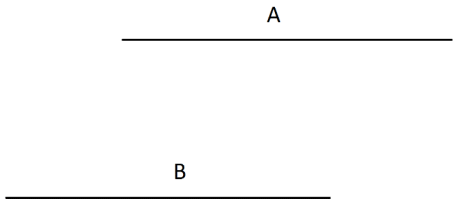
Shown in brackets is the difficulty *d* – the proportion of correct answers in the independent condition – separately for the laboratory experiment ("lab"), small groups in the online experiment ("web-15"), and large groups in the online experiment (web-100").

VISUAL QUESTIONS

v1. Which line is longer?

(A, B)

[*d*: lab: .224, web-15: .489, web-100: .472]



v2. Which shape has the larger area?

(Circle, Rectangle)

[*d*: lab: .357, web-15: .389, web-100: .398]

v3. Which shape has the larger area?

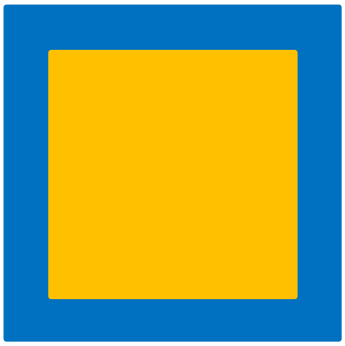
(Triangle, Circle)

[*d*: lab: .337, web-15: .456, web-100: .482]

v4. Which area is larger?

(Blue edge, Yellow center)

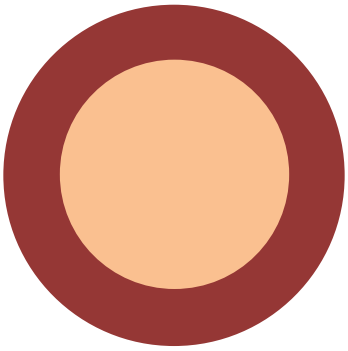
[*d*: lab: .296, web-15: .289, web-100: .314]



v5. Which area is larger?

(Orange ring, Green center)

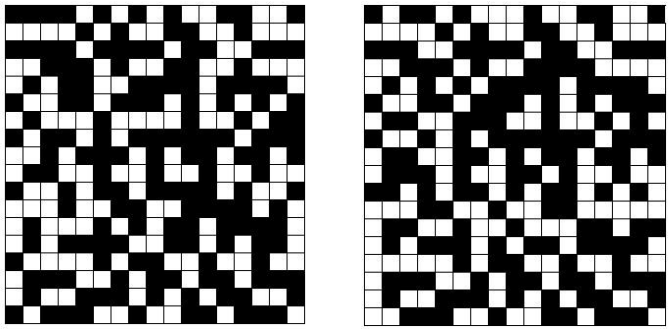
[*d*: lab: .173, web-15: .533, web-100: .521]



v6. Which square has more black cells?

(Left, Right)

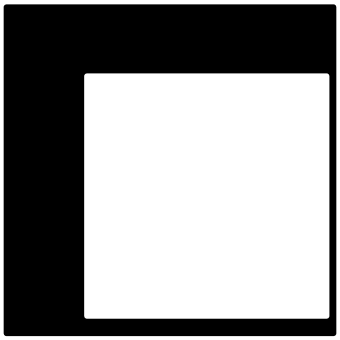
[*d*: lab: .367, web-15: .456, web-100: .457]



v7. Which area is larger?

(Black edge, White center)

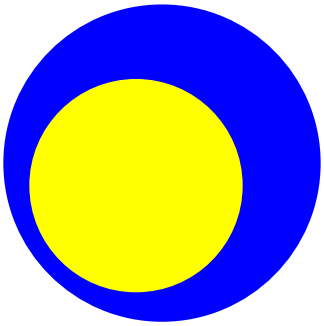
[*d*: web-15: .3, web-100: .275]



v8. Which area is larger?

(Blue edge, Yellow center)

[*d*: web-15: .422, web-100: .367]



v9. Which shape has the larger area?

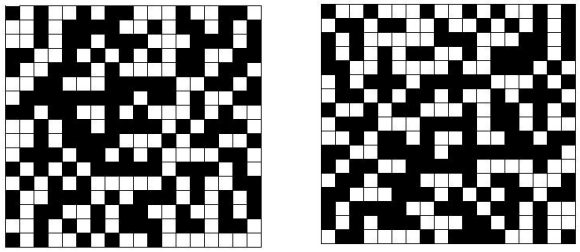
(Triangle, Circle)

[*d*: web-15: .467, web-100: .492]

v10. Which square has more black cells?

(Left, Right)

[*d*: web-15: .578, web-100: .561]



ART QUESTIONS

a1. Were these pieces of furniture designed by the same designer?

(Same designer, Different designers)

[*d*: lab: .214, web-15: .644, web-100: .704]

a2. Which building is an example of baroque architecture?

(Left, Right)

[*d*: lab: .408, web-15: .589, web-100: .596]

a3. Which painting is a Vincent van Gogh?

(Left, Right)

[*d*: lab: .214, web-15: .378, web-100: .399]

a4. From which period is this lamp?

(Before 1990, After 1990)[*d*: lab: .500, web-15: .611, web-100: .586]

a5. What is the style of this painting?

(Impressionism, Expressionism)

[*d*: lab: .204, web-15: .4, web-100: .304]

a6. Who created this statue?

(Leonardo da Vinci, Michelangelo)

[*d*: lab: .143, web-15: .233, web-100: .241]

a7. Which building is older?

(Left, Right)

[*d*: web-15: .311, web-100: .297]

a8. Who painted this picture?

(Picasso, Dali)

[*d*: web-15: .556, web-100: .415]

a9. In which country was this picture taken?

(Germany, France)

[*d*: web-15: .267, web-100: .21]

a10. Who painted this picture?

(Edvard Munch, Vincent van Gogh)

[*d*: web-15: .622, web-100: .631]

EQUATIONS

e1. What is *x* approximately? $x = [(1600/8) + 300] / 2.5$
(*x* = 125, *x* = 200)
[*d*: lab: .429]

e2. What is *x*? $25x = 950 + 5000 / (100)$
(*x* = 40, *x* = 50)
[*d*: lab: .408]

e3. What is *x*? $-(20 + x) = - (72 / 2)$
(*x* = 12, *x* = 16)
[*d*: lab: .173]

e4. What is *x*? $-x + 38 / 2 = 20$
(*x* = -1, *x* = -2)
[*d*: lab: .531]

e5. What is *x* approximately? $628x = \pi$
(*x* ≅ .005, *x* ≅ .05)
[*d*: lab: .490]

e6. What is x approximately? $1 / x = 1 + x$
(*x* ≅ 0.62, *x* ≅ 0.82)
[*d*: lab: .398]

HISTORY QUESTIONS

h1. When was the sovereignty over Hong Kong transferred from the United Kingdom to China?
(1990, 1997)
[*d*: lab: .520]

h2. When did Germany invade Denmark?
(1939, 1940)
[*d*: lab: .388]

h3. To what island was Napoleon banned in 1814?
(Elba, Saint Helena)
[*d*: lab: .571]

h4. Whose wife was Helen of Troy?
(Agamemnon, Menelaus)
[*d*: lab: .633]

h5. When did the French Revolution start?

(1776, 1789)

[*d*: lab: .429]

h6. Which country was a founding member of the European Economic Community?

(Luxemburg, Spain)

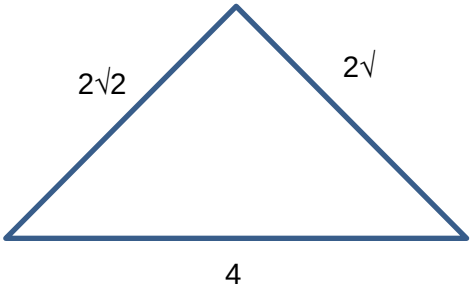
[*d*: lab: .143]

GEOMETRY QUESTIONS

g1. What is the bottom-left angle of this triangle?

(30 degrees, 45 degrees)

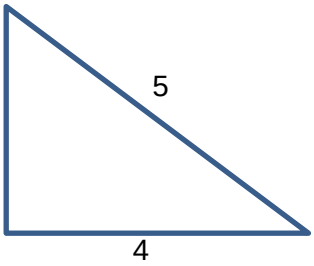
[*d*: lab: .327, web-15: .356, web-100: .383]



g2. How long is the left side of this triangle?

(2.8, 3.0)

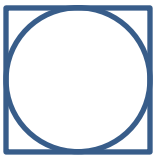
[*d*: lab: .163, web-15: .233, web-100: .262]



g3. The sides of the square have length 3. What is the area of the circle?

(1.50pi, 2.25pi)

[*d*: lab: .633, web-15: .622, web-100: .633]



g4. The area of the largest square is 16. What is the area of the smallest square?

(2, 3)

[*d*: lab: .327, web-15: .289, web-100: .375]

g5. The right side of the blue shape below has length 1. What is the size of the blue shape?

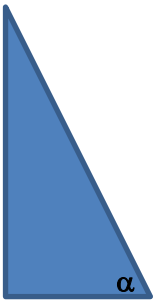
(.625, .675)

[*d*: lab: .551, web-15: .689, web-100: .631]

g6. What is the tangent of α?

(2, ½)

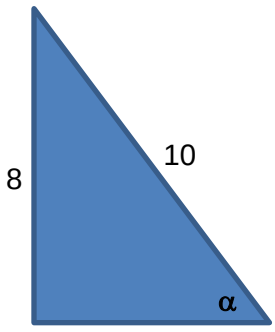
[*d*: lab: .684, web-15: .733, web-100: .668]



g7. What is the cosine of α?

(.6, .8)

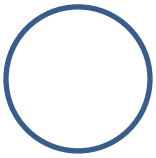
[*d*: web-15: .622, web-100: .614]



g8. The circumference of the circle is pi. What is the area of the circle?

(pi/4, pi/2)

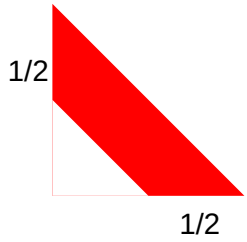
[*d*: web-15: .8, web-100: .806]



g9. What is the area of the red shape?

(5/16, 3/8)

[*d*: web-15: .467, web-100: .476]



g10. What is the size of the red square?

(2, 2√2)

[*d*: web-15: .711, web-100: .618]

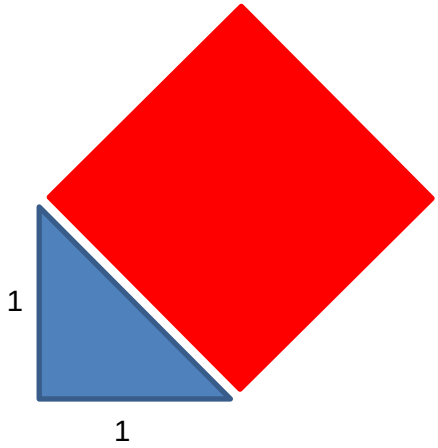
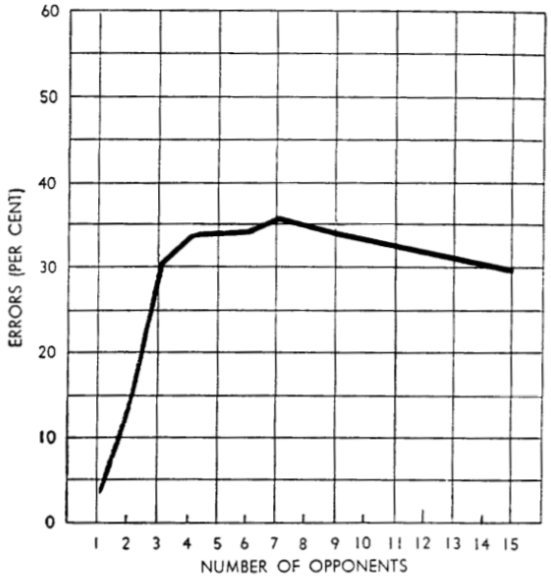


Figure A2. Chart showing the diminishing effect of majority size on conformity after a majority size of three (Asch, 1955).



SIZE OF MAJORITY which opposed them had an effect on the subjects. With a single opponent the subject erred only 3.6 per cent of the time; with two opponents he erred 13.6 per cent; three, 31.8 per cent; four, 35.1 per cent; six, 35.2 per cent; seven, 37.1 per cent; nine, 35.1 per cent; 15, 31.2 per cent.

Table A3. All programs of the Faculty of Social and Behavioral Sciences of Utrecht University

Bachelor's	*Pre-masters*	*One-year masters*	*Two-year masters*
Academische lerarenopleiding	Clinical Child, Family and Education Studies	Applied cognitive Psychology	Sociocultural Transformation
Algemene sociale wetenschappen	Sustainable Citizenship	Clinical Child and Adolescent Psychology	Development and Socialization in Childhood and Adolescence
Culturele antropologie	Educational Sciences	Clinical Child, Family and Education Studies	Learning in Interaction
Onderwijswetenschappen	Contemporary Social Problems	Clinical Psychology	Methodology and Statistics
Pedagogische wetenschappen	Social Policy and Public Health	Sustainable Citizenship	Migration, Ethnic Relations and Multiculturalism
Psychologie	Youth, Education and Society	Educational Sciences	Social and Health Psychology
Sociologie	Youth Studies	Neuropsychology	Sociology and Social Research
		Social, Health and Organizational Psychology	
		Social Policy and Public Health	
		Contemporary Social Problems	
		Youth, Education and Society	
		Youth Studies	

Table A4. Binary logistic regression results for the control condition, with the answer provided as dependent variable.

	Model 1 - Absolute				Model 2 - Relative			
Variable	B	S.E.	Odds Ratio	95% CI OR	B	S.E.	Odds Ratio	95% CI OR
Constant	.783	.223	-	-	.690	.231	-	-
Majority size	-.033	.017	0.97	0.94, 1.00	-.035	.095	0.97	0.80, 1.16
Q1 – Q30[a]	29				29			
Likelihood ratio X^2	615.7^{***}				557.1^{***}			

Note: *p < 0·05; **p < 0·01; ***p < 0·001 (two-tailed tests). Source = Unwise Crowds Data (Frey & van de Rijt, 2019)

[a] Dummy variables for each of the questions were included. The number in the table corresponds to the number of dummy's included. Reference category is Q30 for both models.

In table A4 the logistic regression results for the control condition can be consulted. Its purpose for displaying it here is as a raw sanity check, to see if everything went well in the analysis. As mentioned in the results section, there should not be any effect of majority size on the level of conformity in the control condition as they did not get to see the popularity counts for the questions. As visible in table A4, this is indeed the case. Neither of the majority size effects on the answer provided are statistically significant and they are both in fact in the 'wrong' direction, because the negative sign indicates that an increase in majority size for a particular answer leads to a decrease in likelihood of choosing that particular answer. However, we have to conclude that there is no effect at all due to the insignificance. Therefore, the sanity check is deemed successful.