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Giessner, S. R., and Schubert, T. W. (2019). Power and Vertical Positions in an Organization Chart: A Pre-Registered Replication Report of Study 3a and a Modification of Study 1a, Giessner & Schubert (2007). *Collabra: Psychology,* 5(1): 25. DOI: https://doi.org/10.1525/collabra.216

ORIGINAL RESEARCH REPORT

Power and Vertical Positions in an Organization Chart: A Pre-Registered Replication Report of Study 3a and a Modification of Study 1a, Giessner & Schubert (2007)

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Study 1a of Giessner and Schubert (2007) found a causal effect of vertical spatial cues on power judgments. Recent work showed that this was a false positive (Klein et al., 2018). Here, we test whether another paradigm (i.e., original Study 3a) can be replicated, and develop an adjusted paradigm of original Study 1a to clarify what kind of vertical spatial cues influence power judgments. Our current preregistered Study 1 confirms original Study 3a of Giessner and Schubert (2007). It shows that information about the power of a leader is represented spatially by placing the leader's box higher in an organigram. Our current Study 2 distinguishes vertical ranks from magnitude of vertical spatial difference without changes in rank. The original Study 1a and the failed replication manipulated only magnitude while leaving rank equal. We confirm the null finding here. However, we also find that vertical rank order does indeed affect power judgments, again in a preregistered study, and in line with prior work. In sum, building on earlier work and the failed replication, we clarify that vertical rank order, but not magnitude of elevation, are associated with power judgments.

Keywords: power; rank, magnitude; embodiment; replication

Positions of authority and power in social hierarchies are associated with elevated positions in space, in actual social practice, in metaphoric language, and thought (Fiske, 2004; Lakoff & Johnson, 1980). Over the past two decades, research has attempted to investigate the social-cognitive processes involved in these associations. In general, this work has assumed that there is a bidirectional relationship: Humans are assumed to represent social hierarchies with actual spatial elevation, and to infer hierarchies from elevation.

As a part of this approach, we (Giessner & Schubert, 2007) conducted a series of experiments examining whether the vertical spatial dimension relates to power perceptions of leaders. Study 1a of that series aimed to show that manipulating the length of a line in an organization chart influences subsequent power evaluations of a leader. Recently, the Many Labs 2 project (Klein et al., 2018) included that study in their battery to test its replicability. While our original study had shown a significant effect, $d = 0.55$, there was no effect in the high-powered replication, $d = 0.03$, 95% CI [–0.01, 0.08].

In Study 3a of the same original paper (Giessner & Schubert, 2007), we had tested the reverse effect – namely whether describing a leader as powerful versus powerless would result in placing a box of this leader on a higher versus lower vertical position within an organization chart. In line with this hypothesis, we found that the box of the leader was placed higher in the high leader power condition, $d = 0.86$, $F(1, 153) = 26.01$, $p < .001$. To our knowledge, there has been no attempt to replicate that study.

The failure to replicate the effect of elevation on judgment of leaders' power not only reveals this particular study as a false positive, but also casts doubt on the theory as a whole. We thus have two goals in the current paper. First, we test whether the opposite causal relationship as tested in our original Study 3a can be replicated. Secondly, we also aim to clarify the theoretical background of the prediction in Study 1a, and develop an adjusted paradigm with the goal to learn what went wrong.

Previous Evidence and Theorizing

A multitude of evidence and theorizing suggests a link between the vertical spatial dimension and social power, status, or authority. A larger magnitude in the vertical dimension can mean both size and elevation. Regarding *size*, plenty of previous empirical work reports evidence that taller individuals attain higher levels in social hierarchies (e.g., Judge & Cable, 2004) and are perceived as stronger and more dominant (e.g., Schwartz, Tesser, & Powell, 1982).

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Preverbal infants already pay more attention to scenes in which large actors defer to small actors, apparently inferring power from body size (Thomsen, Frankenhuis, Ingold-Smith, & Carey, 2011). Regarding *elevation*, which is more important here, there is good evidence from reviews of the anthropological literature that it is used to communicate and represent rank and social status (Fiske, 1992, 2004). Judgments of power are slowed down and more error-prone when the agents' vertical positions do not fit the power judgements (Schubert, 2005; Von Hecker, Klauer, Sankaran, 2013; Jiang, Sun, & Zhu, 2015). The link between verticality and social power is mirrored in metaphoric language (Lakoff & Johnson, 1980). Note, however, that our overview of the evidence here is selective; we must assume that this field is subject to publication bias and that true effect sizes are likely smaller than reported (Simmons & Simonsohn, 2017).

Embodied theories of cognition (Barsalou, 1999, 2008), which assume that the mental representation of concepts partly reactivates sensorimotor representations, can provide a basis to explain the link between concepts like power, status, and authority and a vertical dimension. There are other theoretical frameworks as well that provide explanations for specific kinds of effects, for instance based on polarity congruence (Lakens, 2012; Lakens, Semin, Foroni, 2010). Because the focus of the current paper is whether two specific previous studies replicate, we will not got into detail on the theorizing here.

Despite the broad support for a link between vertical space and power, there is disagreement in the details. On the side of social relations, the literature suffers from not distinguishing power, status, rank, authority, dominance, and even competence – typically, all of these are unified under one umbrella (e.g., Hall, Mast, & Latu, 2015). These qualifications should be kept in mind for the current studies, but we will work with the original materials, and thus not be able to make progress on that front. On the side of space, one unresolved question is whether only vertical rank is considered, or whether magnitude plays a role as well. In the non-replicated Study 1a of Giessner and Schubert (2007), the rank order stayed the same while the magnitude of the vertical difference changed (and was hypothesised to have an impact). In most other studies, only rank order was manipulated (e.g., Schubert, 2005). Fiske (2004) has argued that social hierarchies only consider rank order and ignore magnitude information that goes beyond rank.

Study 1: Replication of Study 3a, Giessner & Schubert (2007)

Based on the work linking vertical position and spatial elevation, Giessner and Schubert (2007) argued that for organisational leaders and managers (which inherently imply high rank and elevated power), cues on the vertical dimension of space should be intertwined with judgments of these leaders' power. However, the results of Klein et al. (2018) show that our Study 1a in Giessner and Schubert (2007) was a false positive. This casts doubt on the remaining studies as well. It is thus most important for us to check whether the reverse effect, reported in Study 3a, has the same problem. There, we argued that if a leader is described as powerful, this leader should be mentally represented on a higher vertical position in space compared to the powerless leader, and predicted that this should be reflected in actually placing this leader as more elevated in a spatial task:

> *Hypothesis 1: Information about a manager's power should be reflected in the positioning of the manager on a vertical dimension in space (i.e., y-axis).*[1]

Method

Our replication study was pre-registered using the Open Science Framework blueprint (see https://osf.io/7vcef/). All materials, data and syntax can be found online (https://osf.io/ahx8z/). The study uses a between-subjects design with one factor with two levels (i.e., high and low leader power). Analyses were run after data collection was completed.

Sample

The original paper found an effect size of d = 0.86. In preparation for the current paper, we ran a non-registered pre-test of the study materials (N = 71) and found an effect in the same direction, d = 0.88, already confirming the original finding. With an effect size of d = 0.86, alpha = .05, power = .95, allocation ratio N1/N2 = 1, G-power estimates a required sample size of 74 (Faul et al., 2007), which we set as our minimal sample size for this study. However, because this study was conducted as the second in a series of studies, we actually aimed to collect a much larger sample size of 351 students in total for all studies (i.e., based on the a-priori calculation for the first study on goal-setting in this experimental session). When data collection started in Fall 2017, it was clear that it had to end on 15th December 2017, and would have to be continued in 2018 to reach the 351 total sample size for the other pre-registered study. We thus *a priori* determined that if the sample size by this time was larger than 74, we would stop collecting data for this study and would exchange this study with another study for the package of studies (see https://osf.io/7vcef/).

Our sample size (after stopping data collection in December 2017) was 134 business administration students. After exclusion based on *a priori* criteria (see below), the final sample size was N = 126. A sensitivity analysis shows that this gives us a probability of 95% to detect effects equal to or larger than d = .64. Of these participants, 46 were female, mean age was 19.65 (SD = 1.86), and most had good English proficiency levels (advance: n = 58; intermediate n = 52; basic: n = 23; beginner: n = 1).

Procedure and measures

Participants were recruited at the Rotterdam School of Management. The study was part of a series of three studies we ran in a 30 min session. Before running the studies, we received ethical approval for all studies. Students received an increase in their course grades (i.e., .1 on a 10 point grade scale) for participation. As the study was conducted in English language, we informed participants about the language beforehand. We stopped collecting data mid-December for this study. Everybody in the study pool was eligible for the study.

Participants were placed in separate cubicles and received all instructions via a desktop computer. The study was programmed with Qualtrics (all materials can be found on https://osf.io/ahx8z/). We followed closely the procedure of the original study in Giessner & Schubert (2007). The study was introduced as an ongoing project on person perception. Participants were informed that they would receive some information about a manager and they would be afterwards asked to answer questions about the manager. Afterwards, we manipulated *leader power*. Participants were randomly placed in either a low or high leader power condition. While both conditions provided some general information, such as that the company had 126 employees and the average gross salary was 36000 Euro, the low leader power condition stated that the manager had very little power in the company, whereas the high leader power condition stated that the leader was very powerful within the company.

One the next screen, participants had to place a box that represented the manager into an organization chart (see **Figure 1**). Three boxes representing subordinates were fixed in the lower part of the chart. Participants were asked where the manager box should be placed. In order to do so, they had to move the cursor on the screen and click to indicate the position of the manager box. We measured the x- and y-axis coordinate of this placement. Our main dependent variable was the y-coordinate.

Next, we measured leader power as a manipulation check. We used the same 5-item measure that was previously used in the Giessner & Schubert (2007) paper. Scales ranged from 1 (=totally disagree) to 7 (=totally agree). The five items showed good internal consistency (α = .95). Demographic data of our participants (i.e., gender, age, proficiency level in English) were collected as part of the first study in the series of studies we ran.

Data exclusion

We used two *a priori* exclusion criteria. First, we included an attention check item in the power measure (i.e., 'This is an attention check. Please cross answer "totally disagree".'). Eight participants failed this test and were excluded from the following analyses. Second, the organization chart where participants had to place the manager's box had a border around the area where placement was possible (see **Figure 1**). We marked this area of the organization chart and only included participants who placed the manager's box inside this area. Because all participants placed their response within the box, we did not to exclude participants based on this criterion. The final sample size was 126 (condition high power: N = 68; condition low power: N = 58).

Differences to the original study in study design

There were a few things we changed compared to the previous method. First, the original study was programmed and conducted with Adobe Authorware 7 (https://www.adobe.com/support/authorware/). Because this software is no longer available, we programed our study in Qualtrics (Qualtrics, Provo, UT, USA, https://www.qualtrics.com). Second, as a result, the software package we used in this study did not allow to really drag the box into the organization chart. Rather, we asked the participants to indicate on the screen the placement of the leader box by using the cursor and pressing the left mouse button. Third, the original study used a 2 (leader power: high vs. low) by 2 (perspective: first person vs. third person) design. Because the original study had neither a hypothesis regarding nor found an effect of the second factor, we left this factor out in our design. The method followed the previous "third person" condition. Finally, in the current study participants did not receive money as an incentive. Rather, students received course credits in terms of increases of grades for their participation.

Results

Preregistered analyses

We first ran a Welsh t-test on the measured power perception of the leader to check how successful our manipulation was. Participants perceived the manager as more powerful in the high power condition (M = 5.59, SD = .71) compared to the low power condition (M = 3.00,

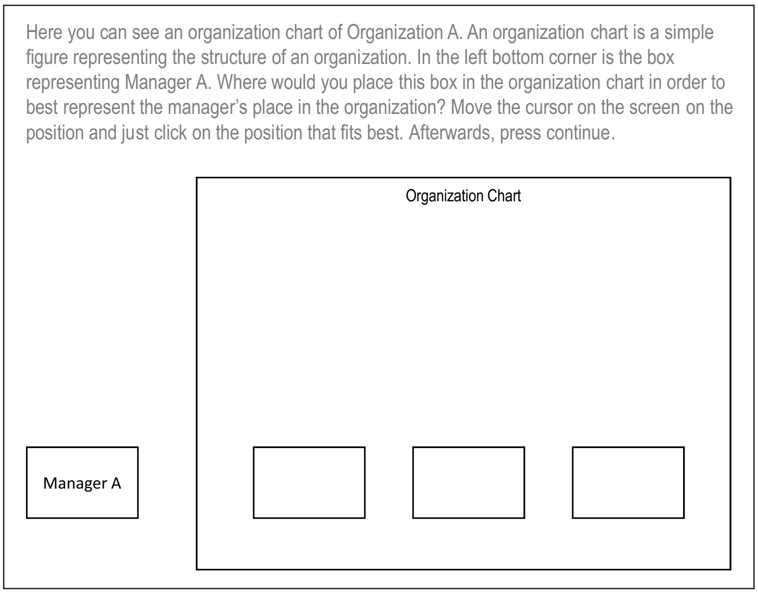

Figure 1: Screen-set up for measuring of y-axis and x-axis positioning in Study 1.

SD = 1.13), *t*(92.53) = –15.03, *p* < .001, *d* = 2.78, CI 95% [2.29; 3.27].[2]

To test our hypothesis, we ran a Welsh *t*-test on the Y-position score. The Y scores we used indicate distance from the top of the screen. To make this visually clearer, we coded these values as negative numbers. Thus, a larger negative score means that the box has been placed further down. As predicted, the participants in the high power condition placed the manager box higher (*M* = –273.65, *SD* = 141.75) than the participants in the low power condition (*M* = –434.67, *SD* = 122.72), *t*(123.968) = –6.83, *p* < .001, *d* = 1.21, CI 95% [.82; 1.59]. **Figure 2** visualizes the actual placement of the participants. Further, the y-position placement is strongly correlated with the measured power perception of the leader (see **Table 1**).

We also explored whether our manipulation had an effect on the X-positioning (i.e., we pre-registered this as an exploratory analysis). A Welsh *t*-test showed that participants in the low power condition placed the manager box more to the left side of the screen (*M* = 737.40, *SD* = 142.02) compared to participants in the high power condition (*M* = 781.56, *SD* = 73.95), *t*(82.65) = –2.13, *p* = .04, *d* = 0.40, CI 95% [.05; .75]. This effect is, however, much smaller than the effect on the y-position (about 1/3 of the effect size) and barely significant.

Additional analyses

We plotted the correlation between the Y-axis positioning and the power perceptions to determine the shape of the relationship between the two variables (see **Figure 3**). Interestingly, while some participants showed the expected positive linear relationship, there seemed to be also a group of participants that seemingly show no relationship. More precisely, some participants seem to have placed the leader in an existing box (values between –480 and –600) independently of their power evaluation.

Given the fact that some participants placed the leader in the lower level boxes, we ran additional analyses. First, we tested whether the leader was placed above the lower boxes within the power conditions. Thus, we run two one-sample *t*-test comparing the Y-positioning to the value of –480 (marking the upper Y-coordinate of the lower boxes). This analyses yielded significant effects for both the low power, *t*(57) = 2.81, *p* = .007, *d* = 0.37, CI 95% [.10; .63], and the high power condition, *t*(67) = 12.00, *p* < .001, *d* = 1.46, CI 95% [1.11; 1.78]. Thus, in both conditions, the leader was on average placed above the lower boxes. Second, we excluded those participants who placed the leader into the lower boxes (28 in the low power condition and 11 in the high power condition). The two conditions did still significantly differ on power perceptions, *t*(39.102) = –9.69, *p* < .001, *d* = 2.57, CI 95% [1.98; 3.15] (high: *M* = 5.60, *SD* = .70, *N* = 57; low: *M* = 3.23, *SD* = 1.24, *N* = 30) and on the y-position score, *t*(54.347) = –5.83, *p* < .001, *d* = 1.36, CI 95% [.87; 1.84] (high: *M* = –221.09, *SD* = 89.72, low: *M* = –335.50, *SD* = 81.49). The result on the x-positioning became non-significant, *t*(39.517) = –1.15, *p* = .26, *d* = 0.30, CI 95% [–.14; .75] (high: *M* = 788.93, *SD* = 33.73, low: *M* = –775.63, *SD* = 58.20).

Discussion

This preregistered study successfully replicated the main findings of the original study. Participants placed the box of a leader in a more elevated position when this leader was described as powerful, compared to the condition where the leader was described as having less power. The effect was stronger in this study than in the original study.

The scatterplot of the relation between judged power and vertical placement reveals a subgroup of participants that placed the leader's box always at the bottom of the picture, basically within the unlabelled boxes that we meant to symbolize the leader's subordinates. We believe that these participants misunderstood the task, and thought that we asked them to *select* one of the prepared

Table 1: Means, Standard Deviations, Cronbach's alpha (in Correlation Matrix Diagonal) and Correlations of the Dependent Variables, Study 1.

	M	SD	(1)	(2)	(3)
(1) Y-Axis	–347.77	155.34			
(2) X-Axis	761.23	112.33	.29**		
(3) Power perceptions	4.40	1.59	.57***	.21**	(.95)

* *p* < .05; ** *p* < .01; *** *p* < .001.

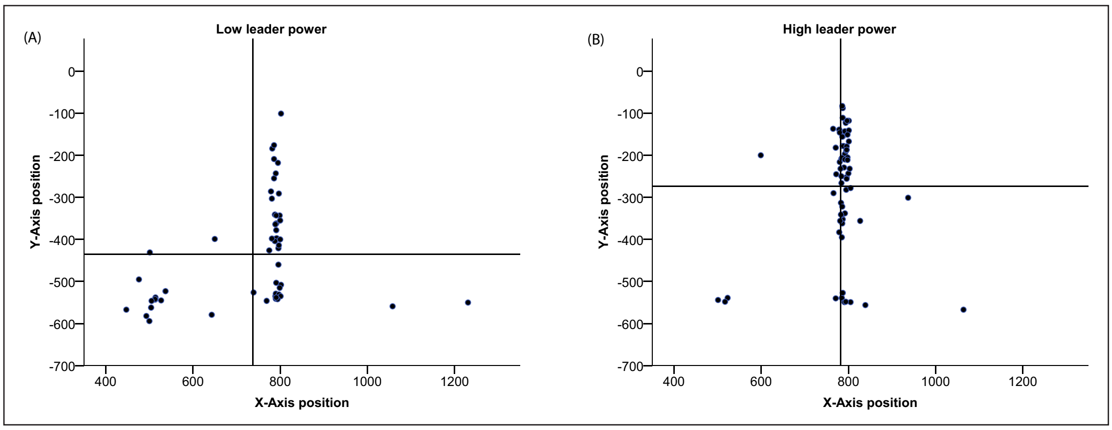

Figure 2: Results for X-axis and Y-axis placement for the low **(2A)** and high **(2B)** power condition. Lines on the X- and Y-axis show the mean value positioning scores in Study 1.

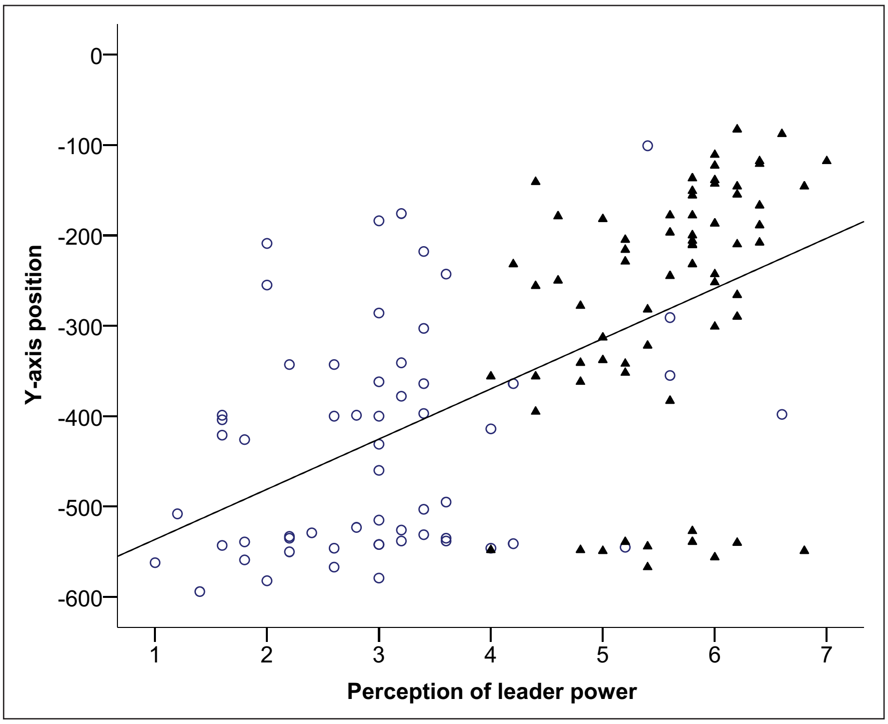

Figure 3: Scatter-plot for the correlation between Y-axis positioning and power perceptions. The line represents the correlation in Study 1. Manipulated conditions are indicated by different symbols in the scatter-plot. Black triangles represent participants in the high leader power condition.

boxes, rather than place a new box in relation to the already present ones. Participants who did not place the leader at the lowest level showed a rather linear increase between judged power and placement of the box on the y-axis. However, most participants performed the task as intended; even participants in the low power condition placed the leader's box on average above the subordinates' boxes, and the results confirm the hypotheses also when those participants are excluded.

The current study showed also an effect on the horizontal dimension in space, although this effect was just a third of the vertical dimension effect. In the original study the effect size of this dimension was $d = 0.2$ which is also within the interval of the current effect size. Participants seemed to move the box of the powerful manager more to the right. Given that we have not set out a specific hypothesis on this effect, we recommend not to over-interpreting this finding. Nevertheless, we find this quite interesting as it seems to be opposing recent research suggesting that a left (versus right) horizontal position might be also related to leaders and powerful groups (Paladino, Mazzurega, & Binfiglioli, 2017). However, there is also some research that is at least suggesting that left positions are related to "lower" or "smaller" perceptions. For instance, Erland, Guadalupe & Zwaan (2011) argued that based on the mental-number-line theory (Restle, 1970) magnitudes might be represented on a horizontal line in space. As a consequence, the left visual field might be related to lower magnitudes, especially numeric magnitude (cf. Dehaene, Bossini, & Graux, 1993). Perhaps there are two competing associations on the horizontal dimension: agency and numeric magnitude, which results in contradicting findings on power depending on which is more important. We certainly recommend more research on solving the contradiction in literature and testing whether this is indeed a reliable effect in this paradigm.

Study 2: Following up on ManyLabs' replication failure with an adjusted paradigm of Study 1a, Giessner and Schubert (2007)

Study 1 established that at least the causal effect of power judgment on spatial representation can be replicated. However, according to the theoretical arguments sketched above, there should also be a causal effect of spatial representation on power judgment. Previous studies supported this hypothesis using various paradigms (see the Introduction, and in addition, Lakens, et al., 2010; Paladino, Mazzurega, Bonfiglioli, 2017; Schoel, Eck, & Greifeneder, 2014; Thomas & Pemstein, 2015). However, the paradigm we used in our 2007 paper did not hold up in the Many Labs 2 replication (Klein et al., 2018). In that study, the position of the manager in an organization chart was manipulated. In both conditions, the organization chart had two levels, with five boxes on the lower level and one box on the upper level. The distance of the leader (i.e., box on the upper level) was manipulated by either being just above the lower level or further up (i.e., length of the line between the two levels varied). We believe that the failed replication of ManyLabs 2 estimates the true effect quite well. There is most likely no effect; our original study was a false positive. In the following, we aim to explore this issue further by varying the paradigm.

Given that power is a relational construct, relational differences in vertical positions should be most indicative to infer power differences. Indeed, Lakens and colleagues (2011) showed that a within-subjects design that manipulated vertical positions showed effects on power judgments, whereas a between-subject design did not. The study of Giessner and Schubert (2007) used a between-subject design. It could therefore be that the manipulation used was not strong enough to provide visual information of relative vertical difference. Alternatively, it is possible that only vertical rank order is interpreted, but that differences in elevation are not used when inferring power.

Consequently, in the adjusted paradigm we added a second leader on the upper level in order to visually show relative differences in power on a vertical position in space. We assume that presenting *two* leaders and manipulating the vertical position of one of the leaders provides a better visualization of relative vertical difference and, thus, should provide an effect on power perceptions. Instead of only two conditions, we constructed 4 different organization charts (see **Figure 4**). In the baseline condition, both leaders are on the same vertical position. The other three conditions manipulated the vertical distance (i.e., being higher up) of the one leader compared to the other leader. Based on these manipulations we pre-registered the following hypotheses:

> *Hypothesis 2: The target leader will be evaluated as more powerful if he is presented above the other leader (condition 2, 3 and 4) compared to below the other leader (rank order hypothesis).*

> *Hypothesis 3: The more vertical distance the target leader has from the other leader, the more power is attributed to the target leader although rank order stays constant (magnitude hypothesis, comparing only conditions 2, 3 and 4). More precisely, we expect that both Condition 3 and 4 will differ significantly from condition 2. Further, condition 4 should differ from condition 3.*

The study was pre-registered, see https://osf.io/m3ajw/. All material, data and syntax can be found on https://osf.io/82uxm/. Analyses were run after data collection was completed.

Method

Sample size

Sample size was initially determined based on a pilot test in which we only had 2 conditions – namely an organization chart in which the target leaders were above or below the other leader (both being above the employees – thus, on the second level of the organization chart). Using G-power, we calculated a sample size of 100 with an alpha level of .05, .80 power (and an expected effect of $d = 0.57$). However, given that we now test 4 conditions, that these differ from the pilot test, and that we do not know the expected effect size for the difference between the other conditions, we aimed to get 400 participants at least. As this study was the second in the series of 3 studies of a

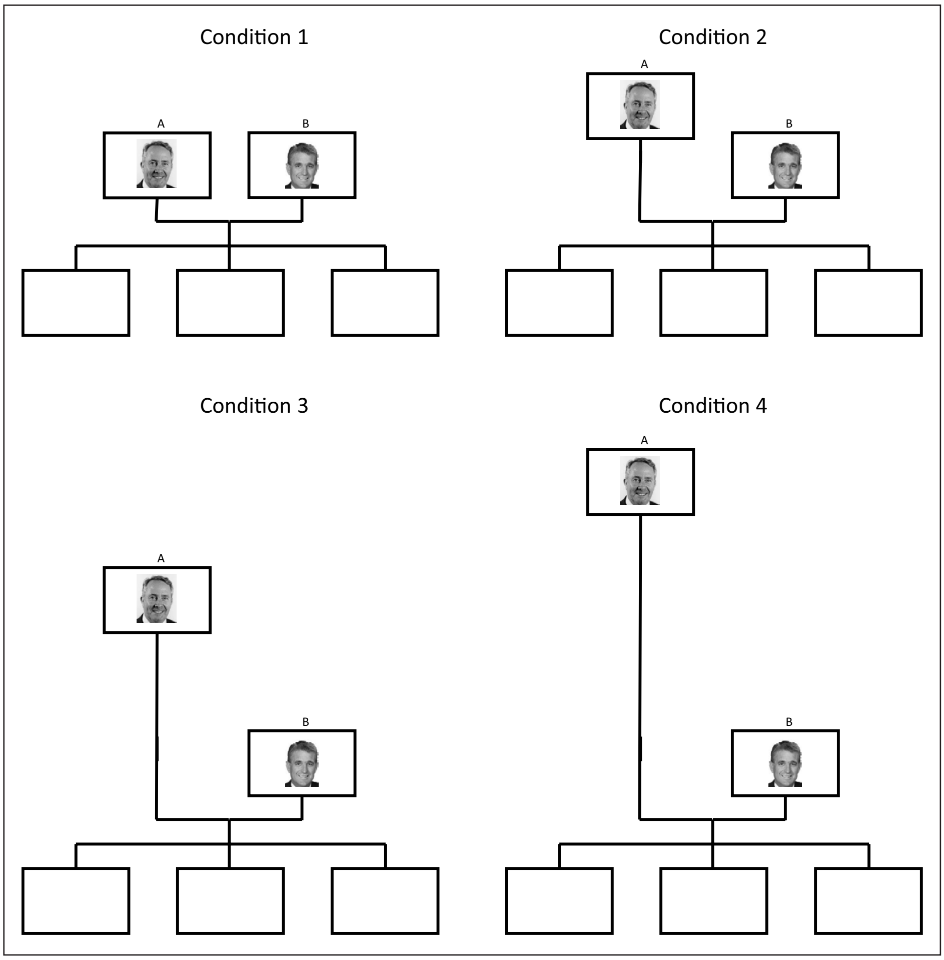

Figure 4: Manipulation of vertical positioning of the leader in an organization chart in Study 2.

battery, the power-calculation of the first study resulted in a necessary sample size of 408. Further, based on the exclusion criteria for the first study, we aimed to collect 450 participants in total and an additional 50 participants should the final sample size of the first study have fallen under 408 after exclusion of participants based on a-priori set criteria (see https://osf.io/nfkjd/). Therefore, the required sample size for this study was 450. In total we collected data from 508 undergraduate business students (Female *N* = 229; Age: *M* = 20.06, *SD* = 1.79), because we needed to collect more participants for the other study. Note that the battery of tests this was run in was different from the test battery in Study 1.

Procedure

Participants were recruited at a Dutch business school. The study was part of a series of three studies we run in a 30 min session. Before running the studies, we received ethical approval for all studies. Students received an increase in their course grades (i.e., .1 on a 10 point grade scale) or 5 Euro for participation. As the study was conducted in English language, we informed participants about the language beforehand. Participants were placed in separate cubicles and received all instructions via a desktop computer. The study was programmed with Qualtrics (all materials can be found on https://osf.io/82uxm/).

Students who had participated in a previous study (see osf.io/7vcef) were not invited for this study, because of the similarity of studies. The study was part of a set of three unrelated studies. The first study was on goal setting. The current study was the second study.

We adapted the design of Study 1a from Giessner and Schubert (2007). Instead of using a one-factorial between-subjects design with 2 conditions, we created 4 different conditions. Similar to the original study, we manipulated the design of an organization chart with two levels. Diverging from the original study, we presented two leaders (i.e. labelled A and B) on the upper level. We constructed 4 different conditions: One in which both leaders were on the same vertical position (condition 1), one where the left leader A was slightly above the other leader (condition 2), one where leader A was clearly above the other leader (condition 3) and one where leader A was very much above the other leader (condition 4) – see **Figure 4**. In all of these conditions, both leaders were still on the same hierarchical level of the organization chart based on actual rank alone (i.e., level 2), because the lines did not indicate that one leader can "overrule" the other. However, while conditions 2–4 had in common that the one leader is on a vertical position above the other leader (in comparison to condition 1), these conditions differed in the length of the line distance of that respective leader. In this way, we could test whether judgments of power are just influenced by vertical rank order or whether it is magnitude of the vertical distance matters. For all of these conditions, we used the same text heading as in the original study (i.e., "Leader A is managing a company employing 126 employees. The average gross salary of the employees of company A is about 36.000 Euro").

Participants were randomly placed in one of the four conditions. After seeing the text with the organization chart, we measured judged leader power of leader A with the scale from Giessner & Schubert (2007; 1 = totally disagree to 7 = totally agree, α = .82). Demographic data of our participants (i.e., gender and age) were collected before the manipulations.

Data exclusion

As an *a priori* exclusion criterion, we included an attention check – asking participants to cross answer "totally disagree" on one item. Forty-two participants failed this test and were excluded from the following analyses. Therefore, our final sample consisted of 466 participants (condition 1: *N* =111; condition 2: *N* = 117; condition 3: *N* = 118; condition 4: *N* = 120).

Results

To test hypotheses 2 and 3, we made use of contrast testing. We preregistered this analysis (https://osf.io/82uxm/). The first contrast tests condition 1 versus the other three conditions (–.75, .25, .25, .25). This test is a direct test of Hypothesis 2. Next, we tested whether condition 2 differed from conditions 3 and 4 (0, –2/3, 1/3, 1/3) and whether conditions 3 and 4 differ from each other (0, 0, –.5, .5). These last two contrasts are tests of Hypothesis 3. We tested these contrast in a linear regression. **Figure 5** shows the means and standard deviations of power perceptions within conditions.

Regressing the contrasts on power perceptions indicates a significant effect for the first contrast, *b* = .28, *SE* = 10, CI 90% [.10; .47],[3] *t*(464) = 2.97, *p* = .003, partial r^2 = .02, CI 90% [.004; .04]. Supporting Hypothesis 2, participants perceived manager A as more powerful when he was placed above the other leader (*M* = 5.09, *SD* = .89) compared to being on the same vertical position (*M* = 4.81, *SD* = .90). However, the second, *b* = .03, SE = 10, CI 90% [–.17; .22], *t*(464) = .25, *p* = .80, partial r^2 < .001, CI 90% [0; .006], and third contrast, *b* = –.07, *SE* = 11, CI 90% [–.30; .15], *t*(464) = –.65, *p* = .52, partial r^2 < .001, CI 90% [0; .01] were non-significant. Thus, we could not find support for Hypothesis 3. Overall, the contrasts explained a significant proportion of variance in power perceptions, R^2 = .02, CI 90% [.01; .04], *F*(3, 462) = 3.10, *p* = .03.

Discussion

Study 2 took a new approach to the question of Study 1a in Giessner and Schubert (2007) – the study that the ManyLabs 2 project failed to replicate. The original study only asked whether the magnitude of a vertical difference mattered for power judgments, and ManyLabs 2' failed replication showed that our initial affirmative answer was a false positive. The more basic hypothesis is whether vertical rank order matters. This was not tested in our original paradigm in the 2007 study, but was the target of many other studies (e.g., Schubert, 2005) – none of which, however, was preregistered to our knowledge. In the current study, we tested both the magnitude and the rank order hypothesis in the same preregistered study. The results are very clear. Rank order matters – vertical elevation is inferred to mean power difference. Magnitude

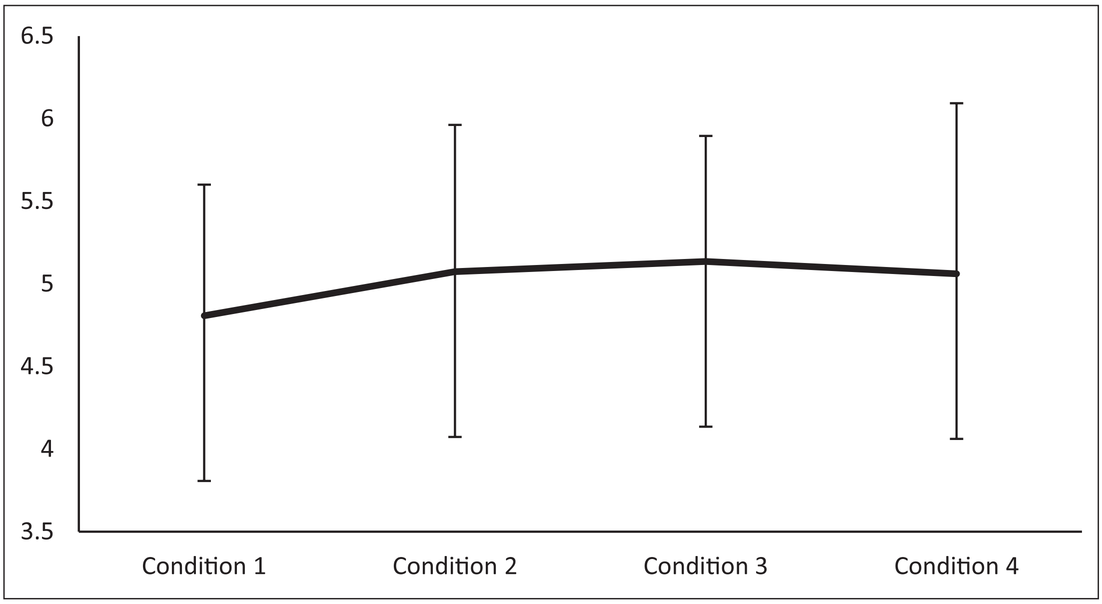

Figure 5: Means and standard deviations of power perceptions of the leader within the different vertical positioning conditions in Study 2.

of spatial elevation beyond rank order did not matter. It is possible that this is partly due to the use of a between-subjects design, which does not offer a direct comparison between the magnitudes. The rank order effect is in line with several studies on the embodiment of power in vertical difference, all of which tested rank order differences (but without differentiating it from magnitudes of vertical difference). The failure to find a magnitude effect is in line with the ManyLabs 2 result.

This result, thus, indicates that conclusions about actual power of a leader might be just based on ordinal scale but not on a continuous one. This finding is in line with Fiske's (1992, 2004) theorizing on the authority ranking relationships (i.e., relationships defined by power differences). He assumed that such relationship follow an ordinal order principle. Further, some prior research on preferred changes in power provided similar results (van Dijke & Poppe, 2003). In this research, participants' preference for changes in power differences were only influenced by the hierarchical rank position but not by the actual degree of power difference (i.e., in the same rank, participants could have different rank positions). Alternatively, it could be that the paradigm is not sensitive to magnitude differences. It is also theoretically possible that a ceiling effect restricted any further effect, but the means (see **Figure 5**) seem to speak against that.

General Discussion

In the current paper, we report two pre-registered studies that follow up on our previous work reported in Giessner and Schubert (2007) and the recent ManyLabs 2 project. The original work investigated the bidirectional link between vertical difference and power judgments. ManyLabs failed to replicate Study 1 from our 2007 paper, which had originally found that a larger vertical difference between a leader and his subordinates in an organigram led to stronger inferences of power than a smaller vertical difference – a false positive, as it turns out. Here, we first replicate Study 3a of the 2007 paper, which looked at the reverse causal direction. We found that stronger impressions of power lead to depicting the leader in a higher position, successfully replicating Study 3a. Next, we created a new version of the paradigm in Study 1a, which allowed us to distinguish the effect of mere vertical rank order from the effect of the magnitude of vertical difference. The results are clear. Vertical difference only matters inasmuch as it sets up a rank order. How much difference there is does not matter. It is possible that it matters in a within-subjects design, but we did not test this here.

There is however an apparent contradiction between the current Studies 1 and 2. While participants in Study 1 show a tendency to express amount of power difference with magnitudes of vertical difference, participants in Study 2 did not interpret such a magnitude. It is difficult to interpret this difference. One possibility is that participants in the high power condition of Study 1 spontaneously imagined additional ranks between the leader and the subordinates, and stacked the powerful leader on top of them. That idea would re-interpret the magnitude effect in Study 1 as a rank order effect, and reconcile the findings in a simple way – following Occam's razor. Alternatively, it might be that differences in perceived power are actually continuously related to vertical positioning, but vertical positioning has only an ordinal effect on power perceptions. While it was not the goal of the current paper to explore this possibility, we hope that future work will try to solve this puzzle.

As a final note, we want to remark on the experience of seeing this study included in ManyLabs 2. The obvious disappointment of the failed replication is easily made up by the correction of the scientific record and our subsequent discovery in the present paper. We are glad that the failed replication prompted us to tackle the difference between ordinal and magnitude information empirically. We sincerely hope that the prominent replication failure in ManyLabs 2 does not lead researchers to conclude that power is not inferred from elevation.

Data Accessibility Statement

All the raw data and analysis scripts can be found on this paper's project page on OSF. Pre-registration can be found on https://osf.io/7vcef/ (Study 1) and https://osf.io/m3ajw/ (Study 2). All data, syntax and materials are available on https://osf.io/ahx8z/ (Study 1) and https://osf.io/82uxm/ (Study 2).

Notes

[1] Note that the preregistered hypothesis included an additional clause that added a theoretical reason, but we removed that part after feedback from reviewers.

[2] All calculations of effect sizes with its confidence intervals are based on the resources provided by Karl Wuensch on http://core.ecu.edu/psyc/wuenschk/SPSS/SPSS-Programs.htm retrieved on 18th March 2019 (CI-d-SPSS.zip). Calculations are based on pooled t and df values. The respective files are uploaded on OSF as well.

[3] Following the recommendation of Wuensch (2019; see http://core.ecu.edu/psyc/wuenschk/SPSS/CI-R2-SPSS.docx; CI-RS-SPSS.zip), 90% CIs are recommended to be reported for r^2 values as these are consistent with the .05 criterion of statistical significance testing.

Acknowledgements

The authors thank Dr. Simone Moran and the two reviewers for their constructive feedback.

Competing Interests

The authors have no competing interests to declare.

Author Contributions

- Contributed to conception and design: SRG, TWS
- Contributed to acquisition of data: SRG
- Contributed to analysis and interpretation of data: SRG, TWS
- Drafted the article: SRG, TWS
- Approved the submitted version for publication: SRG, TWS

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Peer review comments
The author(s) of this paper chose the Open Review option, and the peer review comments are available at: http://doi.org/10.1525/collabra.216.pr

How to cite this article: Giessner, S. R., and Schubert, T. W. (2019). Power and Vertical Positions in an Organization Chart: A Pre-Registered Replication Report of Study 3a and a Modification of Study 1a, Giessner & Schubert (2007). *Collabra: Psychology,* 5(1): 25. DOI: https://doi.org/10.1525/collabra.216

Senior Editor: Don Moore

Editor: Simone Moran

Submitted: 14 December 2018 **Accepted:** 25 April 2019 **Published:** 07 June 2019

UNIVERSITY of CALIFORNIA PRESS | Collabra: Psychology

Collabra: Psychology is a peer-reviewed open access journal published by University of California Press.

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